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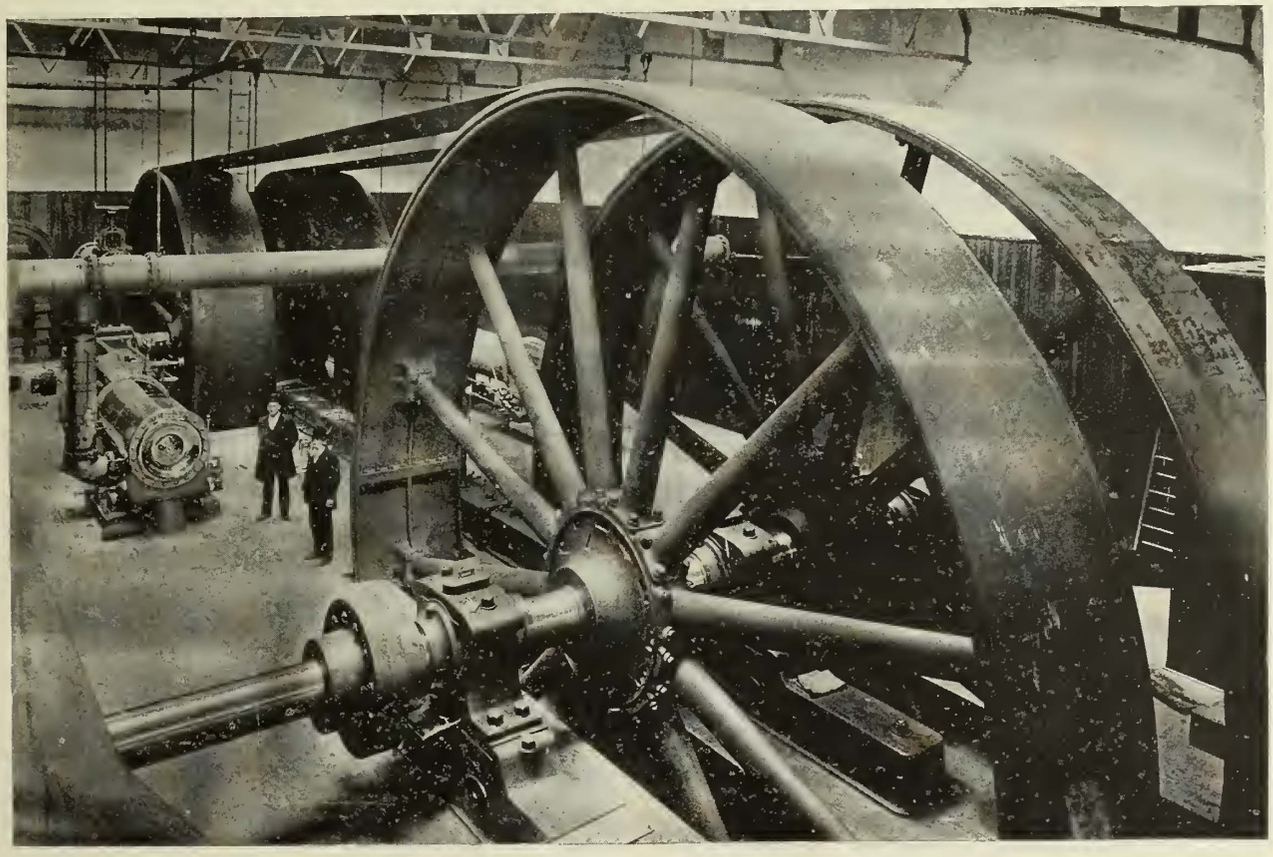
New Engine Room of the Chicago City Railway.

The extraordinary demands that have been made upon the cable lines of the Chicago City Railway Co. within the last year have necessitated a material increase in engine capacity at the power stations. At times the load has been so great that the limit of the reserve power was reached. The greatest demand was made upon the station at Fifty-fifth Street and Cottage Grove Avenue, and the Wheelock engines, which had been in operation there, were removed to make room for engines of the same make and design, but of larger capacity. The former engines were then set up in the new engine room at Twentieth Street, the equipment of which was entrusted to the Robert Poole & Son Co., of Baltimore, to form an annex to the existing power plant.



NEW ENGINE ROOM OF THE CHICAGO CITY RAILWAY.

The new engine room, of which a view is presented in the accompanying illustration, will be, when completed, the most handsome, it is claimed, in the West. The apartment is about 100 x 60 ft., and is part of the space occupied by the offices before they were located in the building adjoining the power station on the north. It is a high, airy, well lighted, and well arranged room. At the east end is built a gallery for visitors from which an excellent view of the machinery can be secured.

The foundation for the machinery in the engine room is concrete, twenty-three feet in depth. The pair of Wheelock engines has a capacity of 2,500 H. P; the cylinders are 36 x 72 ins. The band wheels attached to the crank shaft, which is eighteen inches in diameter, have diameters of twenty-four feet with sixty-two inches face, and each wheel weighs twenty-eight tons. By means of an Underwood sixty inch belt they drive a pair of band wheels, attached to the line shaft, which are thirty-two feet in diameter with sixty-two inches face. The line shaft is connected with that of the original power plant by means of a special sleeve and clutch.

The pair of engines will be capable of operating twenty-two miles of cable, and either of them may be worked in conjunction with either of the other pair of engines in the original plant. The aggregate engine capacity of the power station will be 5,000 H. P., and all the engines are of the Wheelock Engine Co.'s make.

The boilers installed in the station are of the following types: Four Babcock & Wilcox, with an aggregate capacity of 1,000 H. P.; two 500 H. P. Hazelton tripod, equipped with Roney mechanical stokers; and a battery of four tubular boilers made by John Mohr & Sons of Chicago, equipped with Murphy furnaces. All the steam pipes are covered with Excelsior pipe covering. Located in the engine room are two eight inch Schaffer & Budenberg steam injectors and one Worthington steam pump.

The Lindell Railway Co., St. Louis.

The Lindell Railway Co. were among the first of the leading street railway companies of the country to adopt electric power on a large scale, and began the operation of their entire road on the Edison system in the latter part of 1890. Many people at the time predicted that the road could never compete with the two cable roads paralleling it. Considering the simple and telling fact that the number of passengers carried during 1890, the last year horses were employed, was a little over 4,000,000 passengers, and during 1891, the first year of electricity, the number carried was 10,944,585, the exact reverse of what was predicted actually took place. The management tried storage batteries previous to adopting the overhead system, but gave up the system after spending, it was said, over $15,000.

The capital stock of the Lindell Railway Co. is $2,500,000. The president is George D. Capen; vice president, Charles F. Orthwein; secretary and treasurer, James Adkins; general manager, George W. Baumhoff. The company now operate thirty-four miles of road, divided into the Washington Avenue, Van Deventer Avenue and Chouteau Avenue divisions. The former traverses the wholesale business district and the most fashionable residence quarter of the city. From Third Street to Eighteenth Street, on Washington Avenue, a seventy-eight pound Johnson girder rail is used. A sixty-four pound Johnson rail is also employed on parts of both divisions. This rail was laid when horses were used. With light horse car traffic the ties were placed far apart, but on the adoption of electricity the number of ties was doubled. Instead of using chairs to support the rails on the new ties, as in the old construction, wooden blocks were inserted. This was supposed to give elasticity to the track. The latter is at present elastic, but the joints are in a poorer condition than any on the road. Wherever a street was unpaved the company replaced the tram with a girder rail, but to avoid tearing up well laid pavements the tram rail was retained. In the latter case great care was taken in using first class tram construction, and, in consequence, the cars ride as easily as on the girder rail, with a little more oscillation, however, than on the latter. Joints are standing up pretty well under the constant and heavy traffic. All girder rails are placed in Johnson brace chairs. Wherever the street was paved the ties were placed in concrete about two feet six inches apart. A girder curve rail is used of 100 lbs. to the yard.

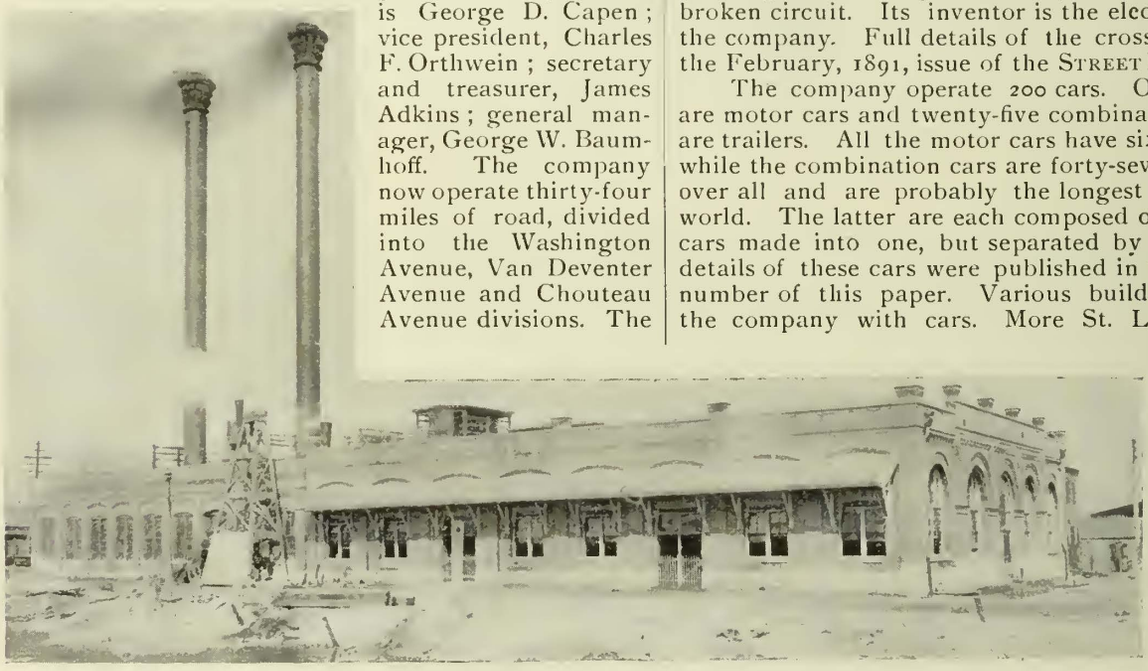


FIG. 1.—EXTERIOR OF POWER STATION—LINDELL RAILWAY CO., ST. LOUIS.

The overhead construction was very costly, and bids fair to stand for years to come. The centre poles on Washington Avenue are very heavy, and weigh 800 lbs. each. They are twenty-nine feet in height, and give a most attractive appearance to the street. At one point, where the street intersects with Broadway, the greatest traffic in the city is to be seen, and the poles are no obstruction whatever. From Eleventh Street to the eastern terminus a second trolley wire is used by the cars of the Bellefontaine railway. Two guard wires over each trolley wire keep off all broken telephone or other wires. Side poles are also used by the company, and are of the three joint pattern. They are twenty-nine feet long and weigh 550 lbs. each. The trolley wire is B. W. G. No. 4 silicon bronze, and the span wire seven strand, galvanized iron. The general manager says that in future they will use nothing but copper for the span wiring and guard wire, as iron corrodes, even if it is galvanized. All poles are placed in holes seven feet deep and twenty-seven inches in diameter. Concrete is then well tamped in about them. The return current circuit consists of two ground wires. The rail joints are bonded with insulated copper wires. The wires of the company cross those of a number of other lines, and in all cases the cars of each company use their own current. The Bagnall trolley crossing is used very extensively, and admits of an unbroken circuit. Its inventor is the electrical engineer of the company. Full details of the crossing were given in the February, 1891, issue of the STREET RAILWAY JOURNAL.

The company operate 200 cars. Of these eighty-five are motor cars and twenty-five combination cars; the rest are trailers. All the motor cars have sixteen foot bodies, while the combination cars are forty-seven feet, six inches over all and are probably the longest street cars in the world. The latter are each composed of two sixteen foot cars made into one, but separated by a vestibule. Full details of these cars were published in the October, 1891, number of this paper. Various builders have supplied the company with cars. More St. Louis Car Co. and Brill cars are used than any others. Each sixteen foot motor car as well as most of the combination cars is supplied with two 15 H. P. Edison motors. Two of the latter are each equipped with two Short gearless motors of 20 H. P. each. Another combination car is equipped with two 20 H. P. single reduction motors of the Westinghouse type. The gearless motors have been running steadily almost every day since last September and are giving good satisfaction. There is an entire absence of noise, and neither singing nor rattling. Brill's No. 7 truck is used on the motor cars of that company's make, while the St. Louis Car Co.'s truck is used on the others. The new maximum traction truck, designed by Mr. Otto Schmid, master mechanic of the company, is used on almost all the combination cars, and has been adopted as the standard for long cars. A large proportion of the sixteen foot cars are of the reversible pattern, that is, can be made open in summer and closed in winter.

The power plant (see Fig. 1) for supplying the current to this large equipment is most advantageously situated beside the tracks of four different railroads. In consequence, the coaling facilities are excellent, the company having a private switch. The station is a plain but attractive structure, 230 × 83 ft., and built entirely of brick. The front of the building faces to the left in Fig. 2, or to the south in reality. The windows of the engine room are high and airy, and on the warmest day a cool breeze is very perceptible. On the western or left hand side in the illustration is a long wooden sunshade. The engine room is 83 × 115 ft. and is separated from the boiler room by a brick partition. There are two rows of pillars supporting the roof, and thus the room is in a way divided into three open hallways, in each of which a traveling crane is provided to lift any piece of machinery. The engines and dynamos are wisely distributed, insomuch that the first hallway to the west is occupied by all

the engines except one, and the second or middle by all the dynamos except one, the extra engine and dynamo being in the third hallway. Fig. 2 gives a good idea of the location of the machinery, but leaves out two engines and four dynamos, which, under the circumstances, could not be included. There are no shifting devices or clutches of any kind employed, but the dynamos are directly belted to the engines.

The present engine equipment consists of seven machines, all of the high speed type. Of these five were made by the Southwark Foundry & Machine Co., of Philadelphia, and are Porter-Allen types; four have a capacity of 250 H. P. each and one of 450 H. P. There are two 400 H. P. engines made by Armington & Sims. The four 250 H. P. engines, and those of 400 H. P. have flywheels each with a diameter of eighty-six inches, that of the 450 H. P. engine being of twelve feet. The weight of the latter is about 16,000 lbs., and of of the others 4,000 lbs. All have tweny-five inches face. The 450 H.P. engine makes 140 revolutions per minute, while the others make 232. The cylinders only of the engines are oiled automatically, while the other parts are provided with feed cups. The Armington & Sims engines were the first installed, and the plant has been gradually increased until its present capacity is over 2,000 H. P. There is plenty of room for an ultimate capacity of 4,000 H. P. This increase will undoubtedly be made in the near future. The management are well satisfied with the results attained by their engines, and consider them superior to low speed for the work required. The electrical equipment includes ten generators, all Edison machines, compound wound, and rated at 200 H. P. and 130 K. W. capacity each, making a total generator capacity of 2,000 H. P. Four of these machines have been added within the last year.

The belts are twenty-four inches wide, are of the link type and were made by the Shultz Belting Co., of St. Louis.

An ingenious device, the invention of Mr. E. J. Bagnall, the electrician of the company, cools the armatures of the dynamos. Around the armature pulley is a sheet iron box, ending in a pipe below the pulley in the same manner as the casing fits around a steam fan. The draft created by the pulley and the link belt is conducted through the pipe which runs along under the armature to the end of the commutator and escapes through holes made in its upper portion, and rushes on to the surfaces of the armature and commutator, thus cooling them off.

The bearings of the armature shaft are oiled automatically in the following manner: On the inner surface of the bearing there is a little gutter along which oil runs, coming from the reservoir beneath the bearing. The shaft fitting in this bearing, consequently, is ever receiving oil on its surface. Connected with the reservoir is a small gauge showing the height of the oil at all times.

There are two switchboards, both of which may be seen on reference to Fig. 2. The one to the left is the main switchboard, and is very neat in construction. On it are located the ten main switches connected with the ten dynamos, and corresponding to the ten main sections into which the road is divided. There are thirty-nine feeders to these sections, and to each feeder there corresponds a field switch. The latter is also the invention of Mr. Bagnall. Its novelty consists in this, that no unscrewing has to be done to insert a fuse, as with the old fashioned switch, but when a fuse burns out the switch handle is thrown to one side on hinges, the fuse is inserted and the handle is thrown back into its former position, pressing against the fuse and keeping it in place. Any one of the sections can be cut out at any time. At the rear of the switchboard are situated the lightning arresters. There are thirty-nine small ones, made by Wirt, of Chicago, each one of which corresponds to a feeder. In case the lightning should pass through any of these, two others, made by Brush, of Cleveland, are provided, and connected in the main circuit. On the small switchboard to the right are situated the rheostats, voltmeters, ampere meters and main switches. The greatest variation in voltage is from fifteen to twenty volts. The voltmeters are of the Weston type, and the ampere meters were manufactured by the Edison General Electric Co.

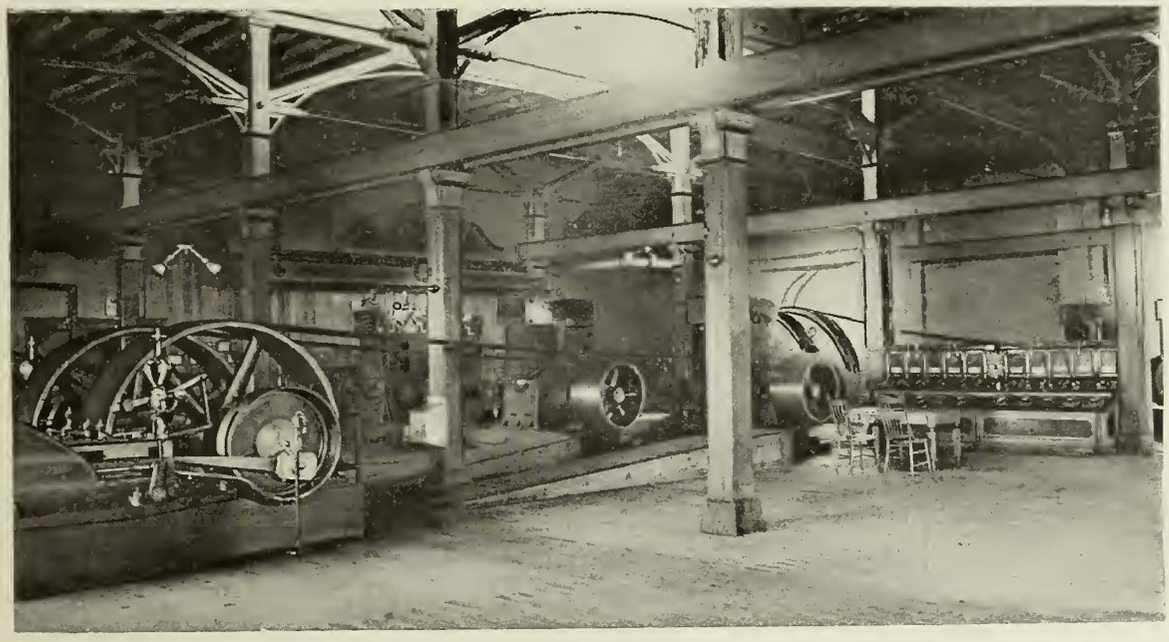


FIG. 2.—INTERIOR OF POWER STATION—LINDELL RAILWAY CO., ST. LOUIS.

The boiler room measures 115 ft. in length and 83 ft. in width. The present equipment consists of ten 200 H. P. return tubular boilers, made by Rohan Brothers, of St. Louis. They are eighteen feet in length, and have a diameter of seventy-two inches. There are sixty-two flues to each boiler, the diameter of each of which is four inches. The boilers are all built to supply steam at 120 lbs. pressure. Two Worthington pumps feed the boilers. One Ludlow heater is used, of 1,800 H. P. capacity, and measuring sixteen feet in length, and fifty-four inches in diameter. An Ashcroft steam gauge and Peerless pressure recorder are doing good service. Water supplied by the city mains is at present used, but the company are having an artesian well dug, as it is next to impossible to use the city water at certain times of the year, because of its being so impregnated with mud, and by using artesian water it is thought that the danger of explosions will be

reduced to the minimum. The well is being dug by the Robbins Drilling & Prospecting Co., of St. Louis. The coaling facilities are of the very best, and without the aid mechanical stokers. A railroad switch enters the boiler from the heater and exhaust pipes empties into them, and is used over again in the boilers. The water is always kept at a certain level.

Another ingenious and economical device is the Stewart oil extracter. All the exhaust steam from the engines is conducted into a chamber, in which there is a kind of receiver made of iron plates. These plates are so arranged that when the steam comes in contact with them it deposits the oil which is clinging to it. This oil is used again for lubricating purposes.

At present the car sheds of the Washington Avenue Division and the offices of the entire company are located at Finney and Van Deventer Avenues. Preparations are being made to move them farther west. The new site will occupy an entire square, 550 x 155 ft., bounded on three sides by Fairfax Avenue, Newstead Avenue, and Taylor Avenue. Fig. 3 is a plan of part of the shed, and Fig. 4 gives a front elevation. It is to be built on the railway station plan; that is, a high roof, truss supported. There are to be fifteen tracks running east and west. This large number will necessitate but two tracks by which the cars will enter and leave the shed. As will be seen by the illustration, no car on going out will run into any switch, all switch points being in an opposite direction. The great advantage of this can be appreciated in case of fire or any other calamity. The entire shed will accomodate 165 combination cars and 300 short or sixteen foot cars. The track work, which consists of a fifty pound T rail, was supplied by the Elliot Frog & Switch Co., of East St. Louis.

The sheds of the Chouteau Avenue diision are located at Chouteau and Jefferson Avenues. Here are located the repair shops of the company. At the time of our visit workmen were very busy building combination cars for the Washington Avenue division. The facilities of these shops are of the very best, and the most efficient and skilled workmen only are employed. The fine work turned out of the shops testifies to this. Both the Washington Avenue and Chouteau Avenue lines terminating in Forest Park, an enormous number of passengers is carried by the company in this direction during the warm months. The company have recently erected a fine pavilion at the park terminus of the Washington Avenue line. This building cost $26,000, is built of fine Milwaukee

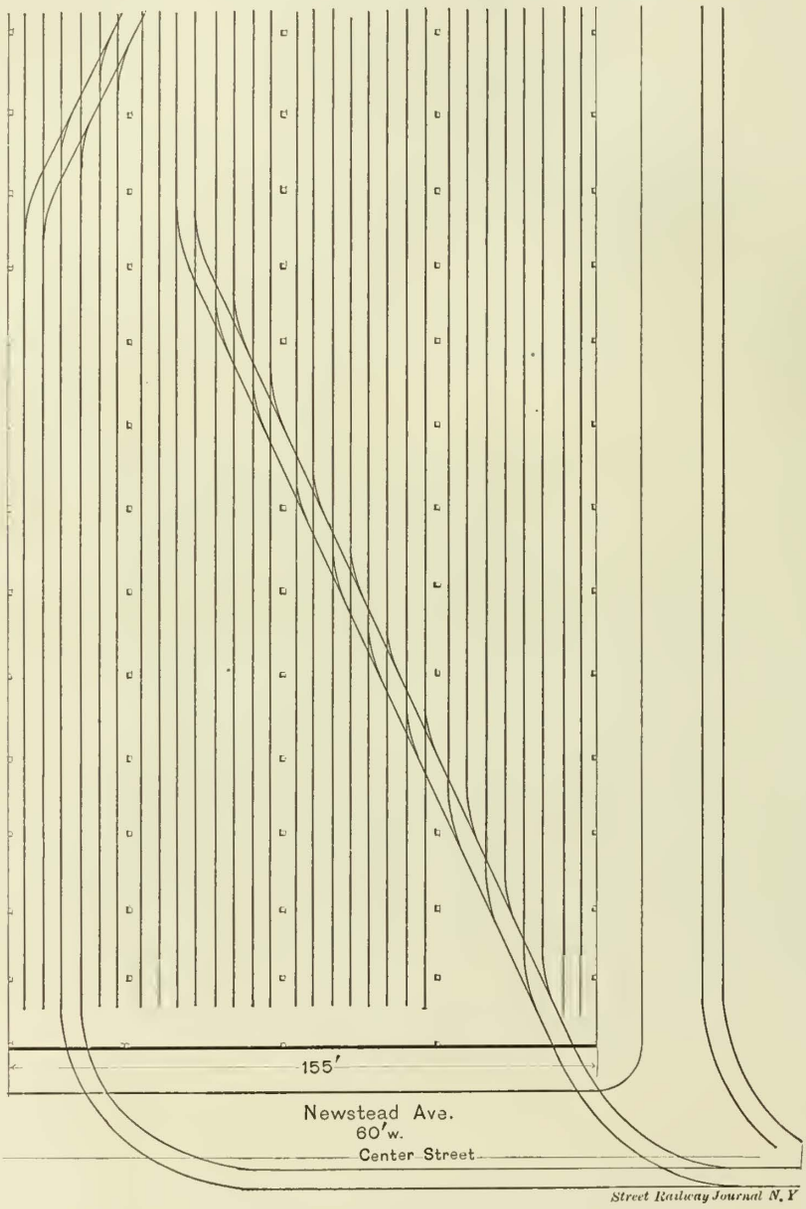


FIG. 3.—PLAN OF NEW CAR HOUSE—LINDELL RAILWAY CO.

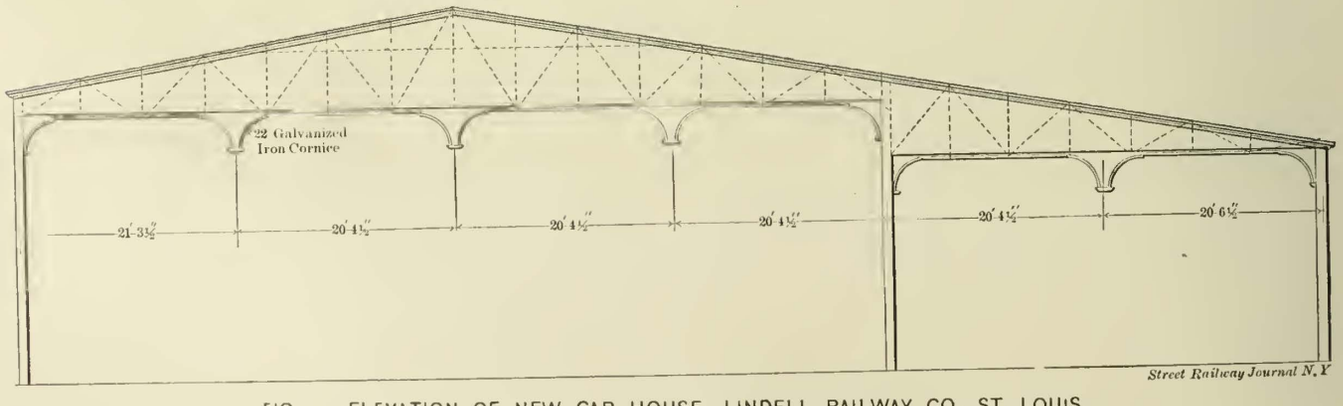


FIG. 4.—ELEVATION OF NEW CAR HOUSE—LINDELL RAILWAY CO, ST. LOUIS.

room not thirty feet away from the furnace doors. Coal heavers shovel the coal from the cars to the floor, and the firemen feed the fires with it whenever necessary. Thus it is handled but twice. There are at present two smokestacks. They are both made of iron, 140 ft. in height, and have a diameter of sixty-six inches. Each is surmounted by an ornamental fluting.

Outside the station a cave has been dug, in which are two hot wells of 10,000 galls. capacity. All the drain pressed brick, is finished and wainscoted in oiled pine, and is lighted by electricity. The tower would be a fine ornament for any large city building. It is about one hundred feet in height, and surmounted by a lookout, and is Norman in architecture. The City Park Department has ornamented the grounds round about the buildings. The front of the building where the cars stop is laid out with a fine granitoid pavement about thirty feet wide and 150 ft. long, providing stopping places for about six cars. S. L.

Massachusetts Street Railway Superintendents' Association.

On invitation of Supt. Geo. A. Murch, of the Worcester, Leicester & Spencer Street Railway, the managers of quite a number of the Massachusetts street railways, assembled at Worcester at noon on Tuesday, April 26, for the purpose of forming an association.

They were met on arrival by Superintendent Murch; escorted to a special car in waiting and conveyed to Spencer, stopping over at Leicester, where an opportunity was given to inspect the model power station and car house of this line. The party arrived at Spencer at about 3.00 P. M., where dinner was served at the Massasoit Hotel, and when the inner man had been satisfied, Superintendent Murch called the gentlemen to order, expressed his gratification at seeing so large a number present and explained the advantages that could be gained through organization. Addresses followed by Superintendent Weeks of Quincy, Superintendent Henderson of Newton, Superintendent Morton of Lawrence, Superintendent Page of Amesbury, Superintendent Bradford of Marlboro and others, and all promised to support such an organization as was contemplated, and urged its immediate formation.

On motion of Superintendent Weeks, it was voted to form the "Massachusetts Street Railway Superintendents' Association" and officers were elected as follows:—

President, Geo. A. Murch, superintendent Worcester, Leicester & Spencer St. Ry.; vice president, Benjamin J. Weeks, superintendent Quincy & Boston St. Ry. Co.; secretary and treasurer, F. G. L. Henderson, superintendent Newton St. Ry. Co. A Committee, consisting of the president, vice-president and secretary, was appointed to prepare a set of by-laws and the secretary was directed to communicate with the superintendents of all the street railways in the state, requesting them to become members.

The new association starts off with an unusual amount of encouragement and promises to do good work in the street railway field. While it is not intended that it shall conflict in any way with the Massachusetts Street Railway Association, its members believe that there is much requiring earnest discussion, that can be better done by the practical working heads of the railways by themselves, rather than when in council with other officials, supply men, etc.

South Side Elevated Road, Chicago.

Unless all signs fail, trains will be running on the elevated system of the Chicago & South Side Rapid Transit Co. during the present month. The rolling stock reached the city early in May. The engines, which are compound, were built by the Baldwin Locomotive Works of Philadelphia, and their general appearance is shown in Fig. 1. They were built in accordance with specifications prepared by R. I. Sloan, chief engineer, and D. L. Barnes, consulting engineer, of the South Side company. The general dimensions furnished by the Baldwin Locomotive Works are as follows:

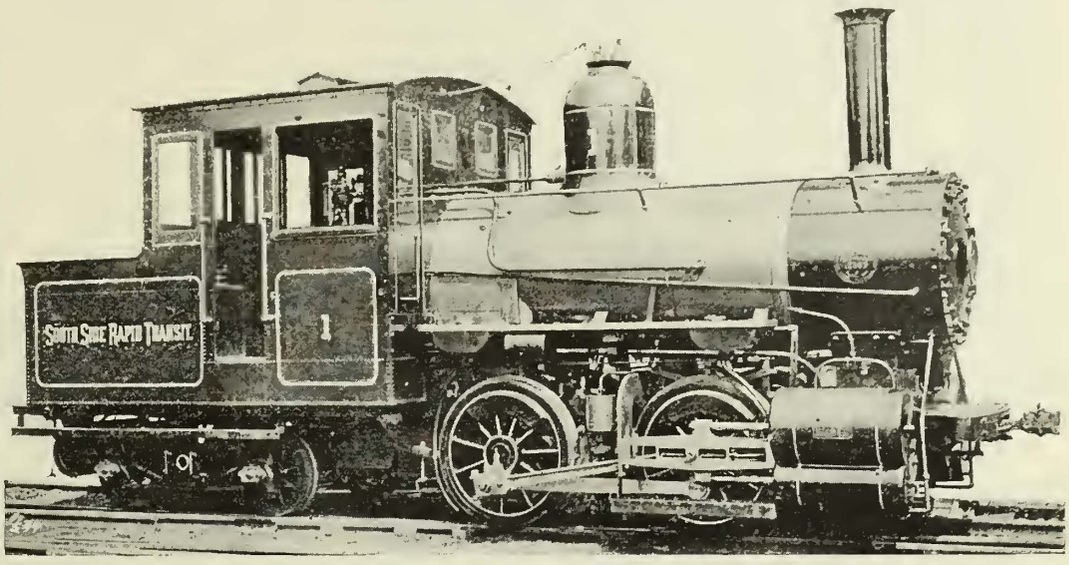


FIG. 1.—COMPOUND ENGINE—CHICAGO ELEVATED RAILWAY.

Gauge, 4 ft. 8½ ins.; cylinders, H. P., 9 x 16 ins., L. P., 15 x 16 ins.; drivers, 42 ins.; total wheel base, 16 ft. 4 ins.; D. wheel base, 5 ft.; weight, total, 58,000 lbs.; weight on drivers, 40,000 lbs.; boiler diameter, 48 ins.; number of tubes, 167; diameter of tubes, 1¾ ins.; length of tubes, 66 ins.; firebox length, 66½ ins.; firebox width, 43¼ ins.; grate area, 20 sq. ft.; heating surface, firebox, 70 sq. ft.; heating surface, tubes, 485 sq. ft.; tank capacity, 750 gals.; bunker capacity, 2 tons.

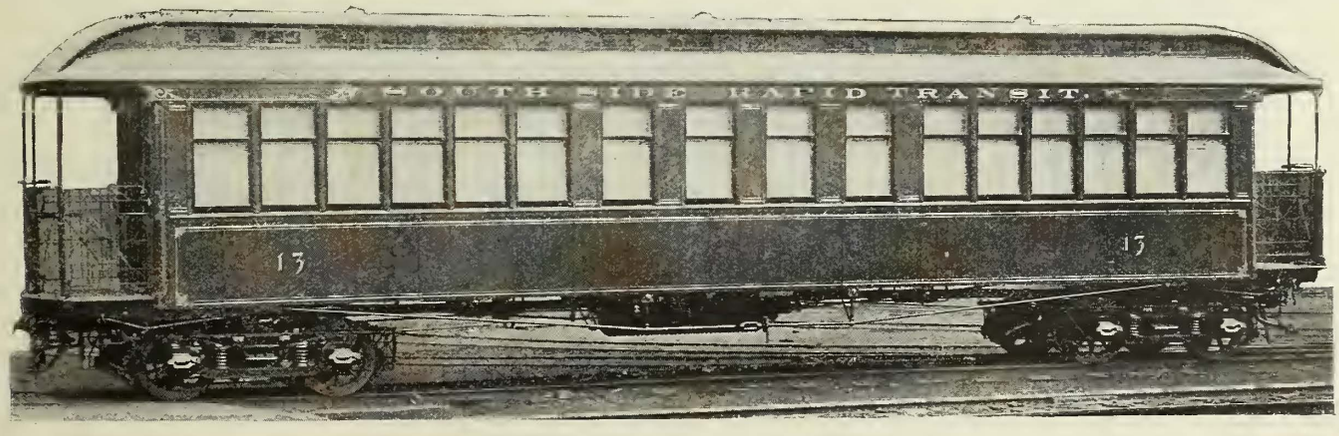


FIG. 2.—PASSENGER CAR—CHICAGO ELEVATED RAILWAY.

The engines combine many novel features which, it is believed, will render them better for service on elevated roads than any locomotives heretofore designed for this kind of work. The compound system practically does away with the offensive noise due to the exhaust steam, and at the same time the throwing out of sparks and cinders is avoided. As anthracite coal will be used no smoke nuisance will be created. The engines are designed to haul five-car trains making an average speed of twenty miles per hour, including stops. The maximum speed between stations, which are located at distances averaging three to the mile, will be from twenty-five to thirty miles.

The engines were sent to Chicago in a train drawn by the compound, ten wheel engine No. 82, built by the Baldwin Locomotive Works, which has become famous for its performances on several railroads. The movement of the train required three relays of engineers and firemen, working eight hours each, to enable the train to run day and night. Pilot engineers were taken over each division of the lines traversed by the train. Seven messengers or machinists accompanied the engines to guard against the possibility of their running hot. The train was in charge of W. J. McCarroll, assisted by Jerome J. Parmelee and H. Burrall.

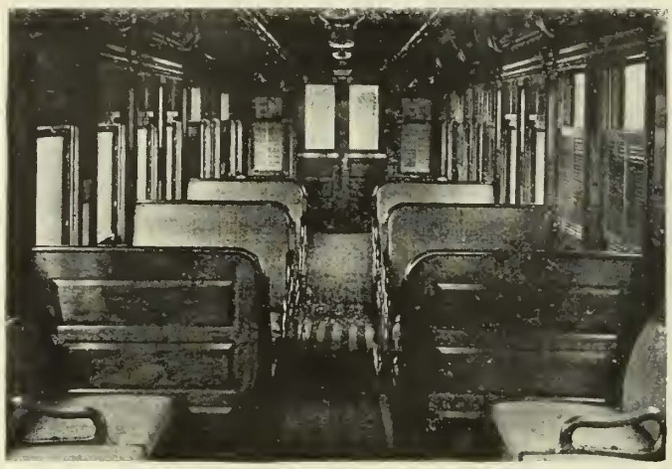


FIG. 3.—INTERIOR OF CHICAGO ELEVATED RAILWAY CAR.

When the train, headed by the powerful compound engine, reached Clifton, Can., the party met with a very disagreeable experience. A customs officer informed the engineer that engine 82 was in his possession and must not be moved. He explained that in accordance with an order in council a locomotive built in the United States must pay duty on its first trip into Her Majesty's dominion, if running under steam. After a brief delay the Baldwin company filed a bond and the train was allowed to proceed. On reaching Chicago the engines were sidetracked near the elevated structure at Fortieth Street, to which they were raised up an incline by means of a donkey engine.

The passenger coaches that are to be used on the line are illustrated in Fig. 2. The car bodies are forty feet in length, and the total length, including platforms, is forty-seven feet. They are handsomely designed, and constructed in accordance with the latest patterns. The manufacturers are the Jackson & Sharp Co., of Wilmington, Del.

Transportation at the World's Fair Grounds.

The contract for operating the intramural elevated railroad at the World's Fair grounds at Jackson Park has been awarded to the Western Dummy Co., of Chicago. The plans of the corporation are not yet defined in all respects; but they have decided to use electricity as a motive power, and Thomson-Houston apparatus will be employed.

The general route of the road was shown in a plan of the World's Fair grounds published in the STREET RAILWAY JOURNAL for January. The elevated structure, which will be supported on wooden posts, will be double tracked. In all probability ten stations of handsome design will be built along the line.

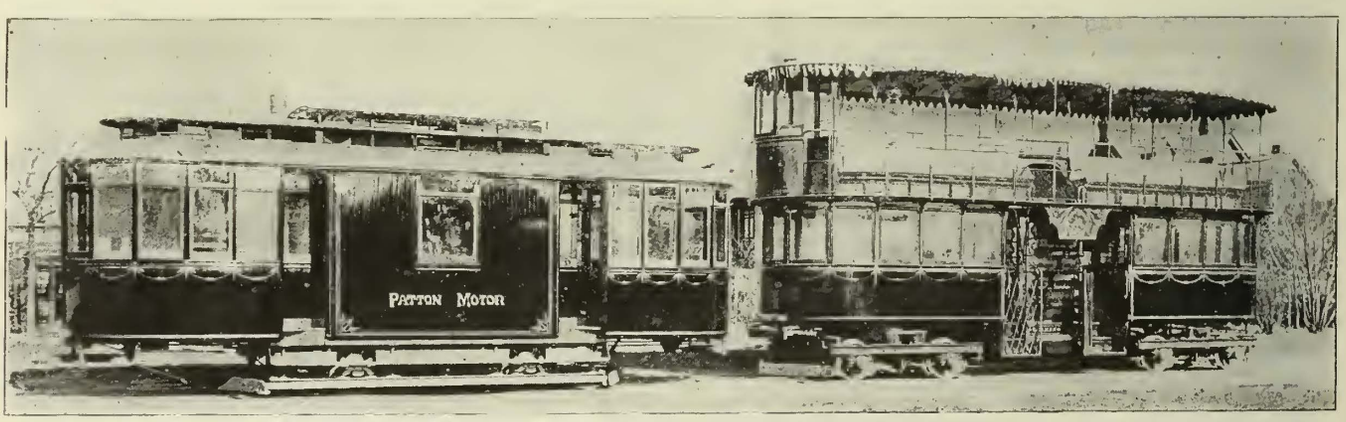
Whether an electric locomotive or motor car will be employed has not been determined, but trains of four cars will be operated. It is proposed to run on about ninety minutes headway, which will be necessary in order to conform to the requirement of the committee that the capacity of the line should be sufficient to carry 20,000 passengers an hour past a given point.

It has been supposed that the road would be supplied with electric power from the main generating station, but the estimates indicate that the requirement will be too great to depend upon the source of supply. The company, therefore, will erect their own station at some point on the grounds, to be decided upon by the authorities. According to the preliminary estimate a station with a capacity of 3,000 H. P. will be necessary.

Test of the Patton Motor.

The latest type of Patton motor was exhibited to a party of street railway men, at Pullman, Ill., May 14. The latest form differs in no essential respects from the motor which has for months been operated successfully at Pullman, and which has been described in the STREET RAILWAY JOURNAL, but experience has indicated that improvements could be made in details, which are embodied in the motor shown in the illustration drawing one of the new Pullman double decked cars. As the engraving shows, the motor is vestibuled, handsome in appearance, with interior decorations of the style characteristic of the street cars of the Pullman Co.

The motor was subjected to an exceedingly severe test with the party of visitors on board, and performed its work excellently, rounding at a good rate the short radius curves, for which the Pullman street car tracks are famous, and making trips from one end of the line to the other at a satisfactory speed. The visitors were pleased at the performance of the motor, and an order for one was placed on the spot.



PATTON MOTOR CAR AND TRAILER—PULLMAN, ILL.

The Patton motor comprises a very complete electrical installation. In the central section is located a gasoline engine which drives by a friction pulley a Bain dynamo. Storage batteries are located under the seats, in which is accumulated the current not required for operating the electric motor. The plan of the arrangement is almost obvious. The engine capacity is a little more than sufficient to operate the motor under ordinary conditions, the slight excess of energy being stored in the battery to be used when needed. As the engine is always in operation a large flow of current is accumulated in the cells when the car stops or is descending a

grade. The current from the battery alone is sufficient to run the motor for a considerable time. This fact was shown to the visitors; the engine was stopped and the motor, depending on current from the batteries alone, rounded the difficult curves at good speed. In actual service the batteries are never exhausted; and for that reason they are bound to give results that are satisfactory in all respects.

The motor car shown in the illustration was recently shipped to Portland, Ore., where it will go into service. The Patton Motor Manufacturing Co. have of late received a considerable number of orders, and motors will be turned out at the Pullman shops.

Work on the Broadway Cable Power Station, N.Y.

A description was given in our last issue of the arrangement of the machinery belonging to the Broadway cable power stations, and we present herewith a view which shows the present appearance of the work at the main cable power station at Houston Street, Broadway and Mercer Street. As mentioned in our last issue, the contractors for the entire work connected with the installation and equipment of the power stations belonging to this road are the Pennsylvania Iron Works Co., of Philadelphia. This company furnishes all the plans of construction and all the machinery which will be required.

EXCAVATION AT BROADWAY AND HOUSTON STREET, NEW YORK, FOR CABLE POWER STATION.

The contractors for the excavation and foundations of the Houston Street station are J. D. & T. E. Crimmins. T. P. Galligan & Son have charge of the work of shoring the banks, and Robert L. Darragh & Co. are the builders.

A double wall is being constructed on the three sides fronting on streets, an inner wall for the support of the building and an area wall. The former is seven feet eight inches thick at base and three feet eight inches at the level of the sidewalk. The area wall is four feet eight inches thick at base and two feet four inches at sidewalk. Both are of brick, and rest upon a continuous concrete foundation thirty inches thick. Excavations have been carried down about forty feet below street level.

The walls at present are built up on the four sides almost to the street level, and a little more than two-thirds of the earth has been removed. This part of the work is being pushed forward very rapidly. Part of the earth is drawn by horse power up the inclined plane shown in the engraving, to the Mercer Street side, the rest being lifted by two steam hoists to the surface, where it is dumped into carts and removed.

There were no quicksands encountered in the excavation as in the Bayard Street station of the Third Avenue line, but considerable water filtered into the excavation and had to be removed. During a considerable portion of the work the amount of water raised by the pumps averaged 1,250,000 gals. per twenty-four hours.

Perhaps the most interesting part of the work is that which has been done on the north and east sides, the latter being the Broadway side and the location of the wheel pit. The north side is next to a building which had to be shored up, underpinned and its foundations carried down twenty-two feet below their former depth. This was a long and difficult undertaking. After the uprights were placed in position, and needles arranged to support the wall, the earth was removed and foundations supplied in sections of twenty feet. So successfully was the work done, however, that the most careful measurements show no settlement of the building amounting to one-eighth of an inch.

The excavations on the east side under Broadway extend out a horizontal distance of forty-eight feet from the main wall of the building, the sidewalk and street pavement to several feet beyond the east track of the cable line being supported on trusses and girders. Considerable difficulty was encountered with the pneu-

matic tubes, water, gas and other pipes for which special provision had to be made. The largest and most important of these was a thirty-six inch water main which was located almost directly under the east track of the road. This main was shored up while the brick foundation upon which it now rests and which also forms the back wall of the wheel pit was built under it for its support. The Western Union pneumatic tubes are carried in the pit between the tracks just above the main cross girders and in plain sight from the pit. The rest of the pipes, which are from twenty to twenty-five in number and which include a twelve inch water main and an eight inch gas pipe, are carried below the surface of the street between the west track and the curb stone and above the pit. This space, which has a cross section about 12 × 5¼ ft., has a bottom and a top layer of concrete, the intervening space being filled with sand in which the pipes rest. The water mains are so arranged that if a leak should occur in them, the water will not leak into the engine room or pit, but will empty into drains especially provided for that purpose.

Milwaukee Street Railway System.

The entire railway system of Milwaukee will eventually be one of the most extensive in the country. Mr. Henry C. Payne, the vice-president of the Milwaukee Street Railway Co., who will ultimately operate all the lines in the city, is authority for the statement that if all the extensions now contemplated are built, between 175 and 200 miles will be traversed by electric cars. The system as now actually planned out will be about 125 miles in aggregate length. For service on the several lines from 250 to 300 cars will be required, and about 1,200 men will be employed. Milwaukee with its population of 230,000 is so compactly built that when the improvements are finished a person can travel from any point in the municipal limits to the centre of the city within thirty minutes. The work of equipping the system for electric traction is proceeding with rapidity, and the construction is being done with great thoroughness.

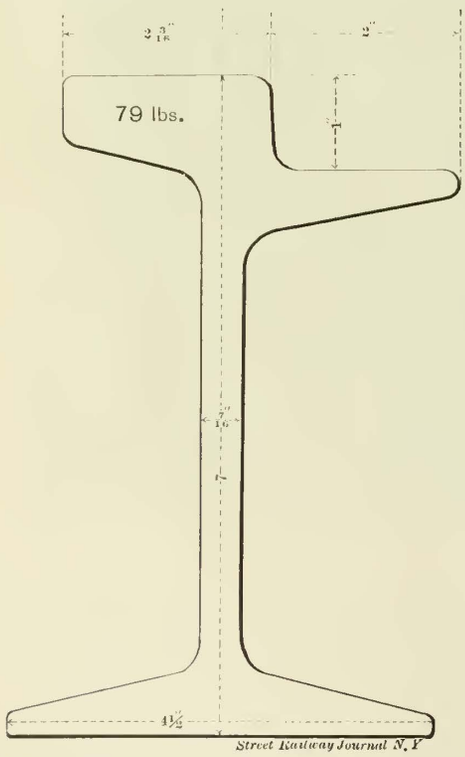


FIG 1.—RAIL—MILWAUKEE STREET RAILWAY.

The tendency of street railway companies to follow in the lines laid down by steam railroads is illustrated very forcibly in Milwaukee, both in general and in details. Cedar ties are now used, but hereafter oak will be used to a considerable extent. An order for 250,000 oak ties was recently placed in Missouri where oak is not much more expensive than cedar in Wisconsin. The change is made not because it is believed that oak will prove more durable, but because this wood will hold the spike better.

The rail which is the standard adopted by the Milwaukee Street Railway Co. is shown in Fig. 1. It was designed by the chief engineer, Mr. Bentzen and his predecessor Mr. Meyer, and is rolled by the Illinois Steel Co. In Milwaukee not so much stress is laid on the weight of rail as upon the manner of laying it. In streets paved with cobble stones or wooden blocks a five inch, fifty-eight pound rail is used; when wooden block paving is used a seven inch, seventy-nine pound rail is laid. The method of laying the rails is the same for both weights. They are spiked directly to the ties, as was done in part of the construction for the Minneapolis electric railway. Fig. 2 shows a section of track which has just been laid in West Water Street.

FIG. 2.—SECTION OF TRACK—MILWAUKEE STREET RAILWAY.

Great care has been taken with the work at the joints. The practice followed is not to locate the joint directly on a tie, but to place ties within two or three inches of the ends of the rails. Heavy splice bars are used to support the joint; those for the seventy-nine pound rail are thirty inches in length; and those for the fifty-eight pound rail measure twenty-four inches. The former are held by six bolts and the latter by four bolts. Iron rail braces are spiked directly to the ties, as shown in Fig. 2. They are set at distances of five feet where stone pavement is used, and at double that distance in all other cases.

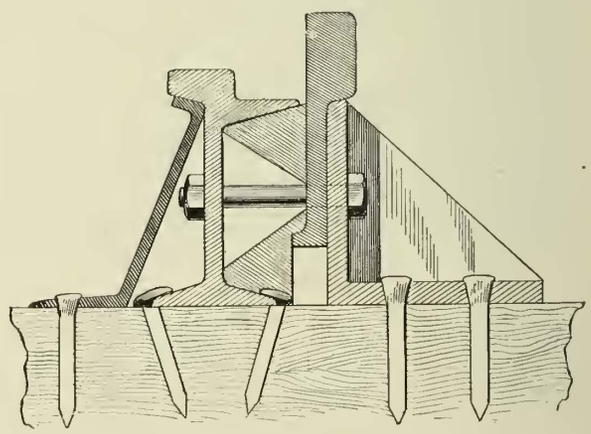


FIG. 3.—GUARD RAIL FOR CURVES—MILWAUKEE.

Great attention has been paid to the curves which, in all new work, are made on the transition plan as follows: The first five feet are bent on a radius of 200 ft., the second five feet on a radius of 100 ft., the next five feet on a radius of 66.6 ft.; the centre of the curve on a radius of forty-five ft. for the inner rail and fifty feet for the outer rail; the curves ease back into line by the same gradations, being bent on radii of 66.6 ft., 100 ft. and 200 ft. as before, but in reverse order. The construction of the curves on this plan has proved very successful. Cars can take the curves at full speed not only without danger of derailment but almost without shock.

The guard rail used on the curves is formed of an old tram rail formerly used by the company. The mode of using it is shown in the sectional view, Fig. 3. The results following the construction briefly outlined here have been highly satisfactory to the company. The engineers state that not a solitary joint in the forty-five miles of track laid last year has given them a particle of trouble. They stand up to their work in admirable fashion, as one may ascertain by riding over the line.

The street railway system, of Milwaukee, as already stated, will eventually be controlled and operated by Milwaukee Street Railway Co. While they have secured by contract both the Becker and the Hinsey lines they have not yet passed into the company's possession. When they assume control, power will be furnished from the station on River Street. The other power stations now operated will then in all probability be abandoned.

In the power station will be located the electric generating apparatus owned by the syndicate which controls the electric lighting, both arc and incandescent, and the street railways operated by the Milwaukee Street Railway Co. At the present time the incandescent dynamos, which are Edison multipolar machines, are located on the second floor. A temporary plant furnishes current for the street railway system, but work is now in progress for erecting three 200 K. W., Edison multipolar generators which will constitute the first installment of apparatus. The Milwaukee Street Railway Co. operate at the present time about forty Edison double reduction motors which have proved highly efficient in service. Since October last when they were first put in operation not an armature or field has been burned out.

The Trolley for Detroit.

The Detroit Citizens' Street Railway Co., have finally made positive arrangements for the introduction of the trolley system into Detroit, and have closed a contract for electrical apparatus with the Detroit Electrical Works. The portion of the line selected for operation by electric power is that on Jefferson Avenue as far as Baldwin Avenue, and it is stated that the line will certainly be in operation by August 1. The contract includes the entire power plant, station, overhead lines and motor equipments.

The power station steam plant will consist of three horizontal, return, tubular boilers, sixty-six inches in diameter, sixteen feet long, each to have sixty four inch flues, and three 14-24 × 14 Westinghouse automatic, compound engines, with all necessary apparatus, such as feed water heater, pump, injectors, piping, smoke stack, etc.

The power station electric plant will consist of three 100 K. W. multipolar railway generators of the Detroit Electrical Works' latest type, as well as slate switchboards of the latest and most improved design, with all instruments and attachments necessary to make a complete electric plant.

The overhead construction will consist of two No. 0 B. & S. hard drawn copper trolley wires, with necessary feeders and guard wires, supported on Milliken iron poles. The standard pole of this firm will be used for that portion of Jefferson Avenue which is seventy feet from curb to curb, and the Milliken extra heavy pole where Jefferson Avenue is eighty feet from curb to curb.

The motor equipment will consist of twelve forty H. P. motor equipments of the Detroit Electrical Works standard type.

Power Plant of the Columbus, O., Consolidated Street Railway Co.

About one year ago the Columbus Consolidated Street Railway Co. of Columbus, O., decided on changing from horse to electric power. Their station, which is described herewith, is especially interesting because at present it contains both high and low speed engines, and the relative advantages of the two, as installed, can be easily compared.

The power house is a substantial brick structure 120 × 126 ft. The engine room is 66 × 120 ft., and the boiler room 55 × 120 ft. The brick chimney is eight

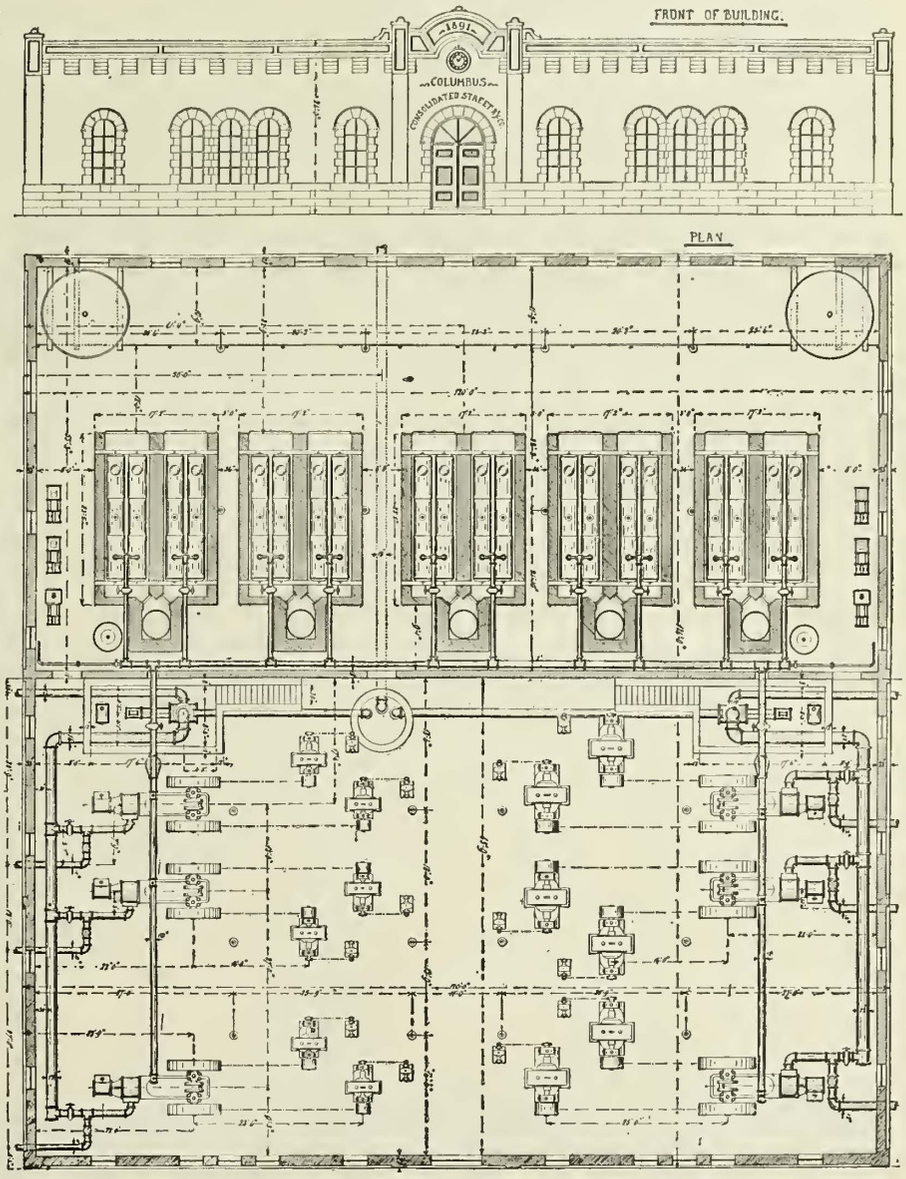


FIG. 1.—ORIGINAL PLANS FOR COLUMBUS, O., CONSOLIDATED STREET RAILWAY POWER STATION.

feet inside diameter and 170 ft. high, on foundations twenty-eight feet deep. The stack proper contains 1,000,000 bricks. For the first thirty feet the stack is built square; above this it is circular and is circular inside its entire height.

The plant is compound, condensing, the water being taken from the river 120 ft. distant, through a tunnel opening into a covered well located under the coal bin. From this point the condensing water is taken through pipes to the condenser, located in a sunken pit in the engine room.

The railroad track runs in front of the boiler room, discharging coal from the cars into the coal bins immediately in front of the boilers. The latter are six in number, were furnished by the Babcock & Wilcox Co. of New York, and have an aggregate capacity of 1,076 H. P. The condenser and feed pump are of the Blake company's manufacture. The heater was supplied by Stilwell & Bierce, and the Robinson separators are used throughout.

The high speed portion of the engine equipment consists of three McIntosh & Seymour compound, condensing engines, special railway type, rated at 250 H. P. each, and having cylinders 13 and 23 × 17 ins. (see Fig. 2) each belted to three generators. This arrangement, it is claimed, gives great compactness combined with flexibility, i. e., each boiler unit is proportioned to the engine unit, and each engine runs its own generators, each engine being entirely independent of the others. Fig. 1, on the preceeding page, shows a plan and front view of the station, as originally designed, to use high speed engines throughout. The high speed engines, together with the rest of the steam plant already described, were furnished by Pierce & Thomas of New York, who also furnished the plans and did the original

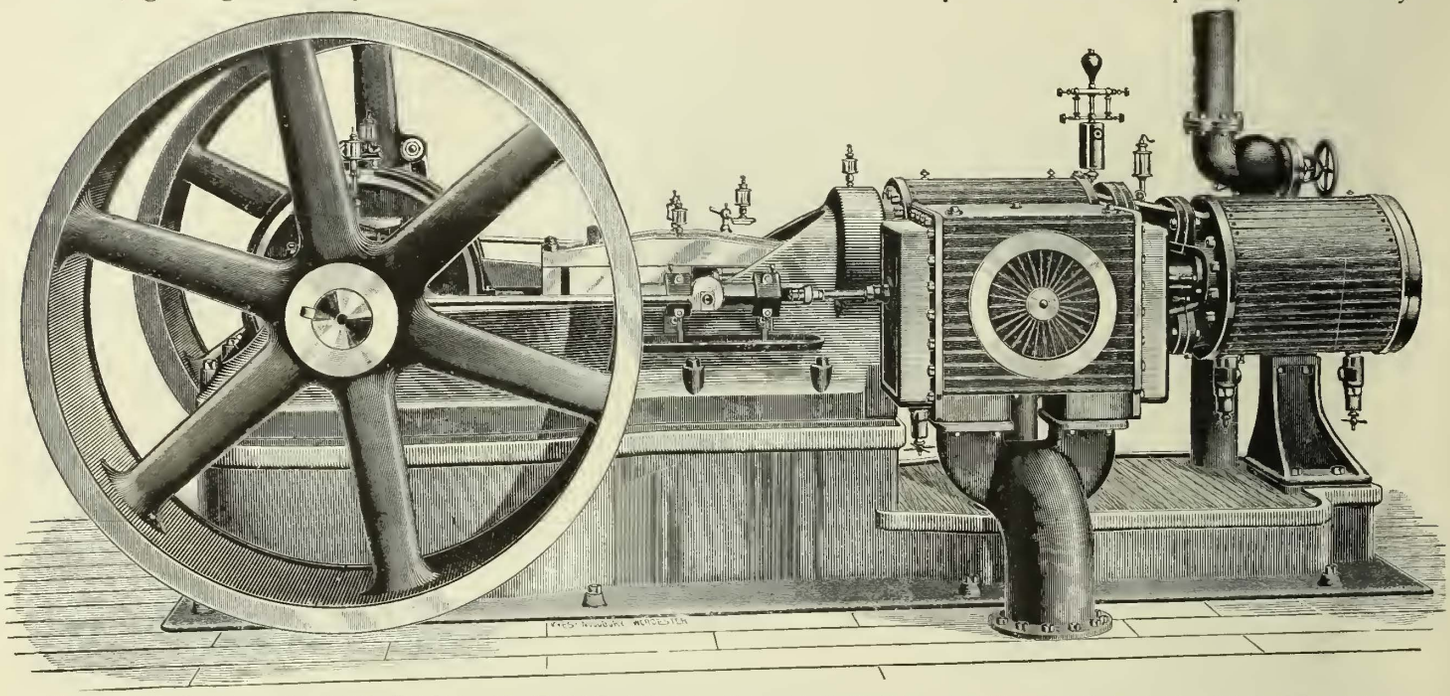


FIG. 2.—M'INTOSH & SEYMOUR TANDEM COMPOUND ENGINE—COLUMBUS CONSOLIDATED STREET RAILWAY POWER STATION.

engineering and construction work of the plant entire, turning the same over to the railway company in complete running order. The original plan, as shown in Fig. 1, was that each engine should drive two M. P., eighty K. W. Thomson-Houston generators, but as the traffic of the road increased more power was found necessary, and a third generator was added to each engine, making the load 330 H. P. on each, which has been carried without the slightest trouble or derangement for some eight months.

The piping throughout is made with flanged connections, fitted with valves at all points necessary to make the plant flexible, and any boiler or any engine can be thrown in or out of commission at will. The exhaust pipes from each engine are fitted with shut-off valves at their junction with the main exhaust pipes running to the condenser. In addition to this, each engine is provided with an exhaust opened to the atmosphere, controlled by a Wheeler automatic, atmospheric valve, enabling the engineer to work any engine in the battery condensing or non-condensing at will. All live steam cylinder jackets and receivers are drained by a Blake pump and receiver working automatically.

Recently the trackage of this company has been increased, requiring more power, and the company decided to try slow speed engines. The new power equipment consists of two 800 H. P. engines (Fig. 3) built by the

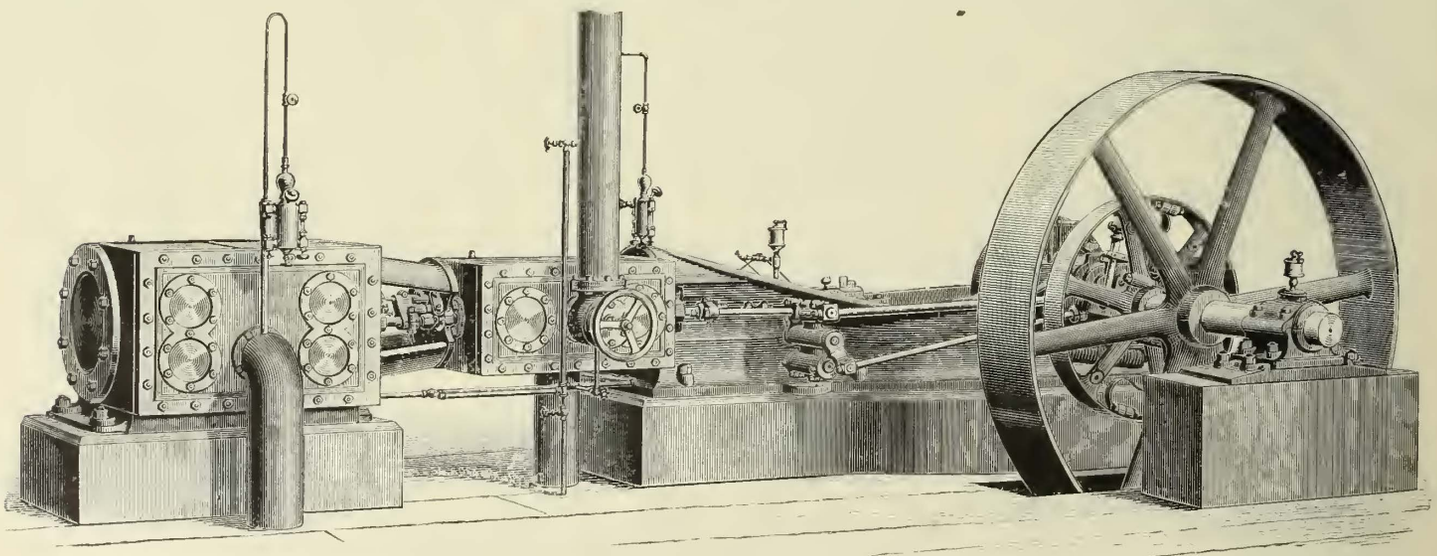


FIG. 3.—BUCKEYE TANDEM COMPOUND ENGINE—COLUMBUS CONSOLIDATED STREET RAILWAY POWER STATION.

Buckeye Engine Co. of Salem, O. The high pressure cylinders are twenty inches diameter, low pressure cylinders thirty-six inches diameter by thirty-six inch stroke, and the speed is 120 revolutions per minute. The flywheels of the engines are fourteen feet diameter by twenty-one inch face, turned crowning for a twenty inch belt, as it is intended in the future to utilize the wheels for driving additional generators One engine is directly connected by jaw clutch couplings to each end of an intermediate shaft, so either or both engines can operate the entire length of shaft at will. The general arrangement is clearly shown in Figs. 4 and 5.

The friction clutch pulleys, which are the largest pulleys of the type yet made, are twelve feet diameter by thirty-eight inches face, and are made of wood with a steel rim on the outside. These are designed to drive generators of 500 H. P. each, and have been tested and found capable of carrying a much greater load. The shaft is in one piece, is thirty-six feet long and nine and a half inches in diameter. The friction clutch pulleys and couplings are all operated by worm geared shifters. The clutch pulleys and shaft were furnished by the Falls Rivet & Machine Co. of Cuyahoga Falls, O. This arrangement of one engine at one end and another engine at the other end with a clutch from each engine, permits of either engine driving any generator, or when necessity requires, the second engine can be connected to service without reducing the speed of the working engine in order to do so. The building being built before contract was placed prevented the addition of a friction cut-off coupling in the centre of shaft, so that one-half of the plant, including shafting and two pulleys as well as one engine, could stand idle if desired.

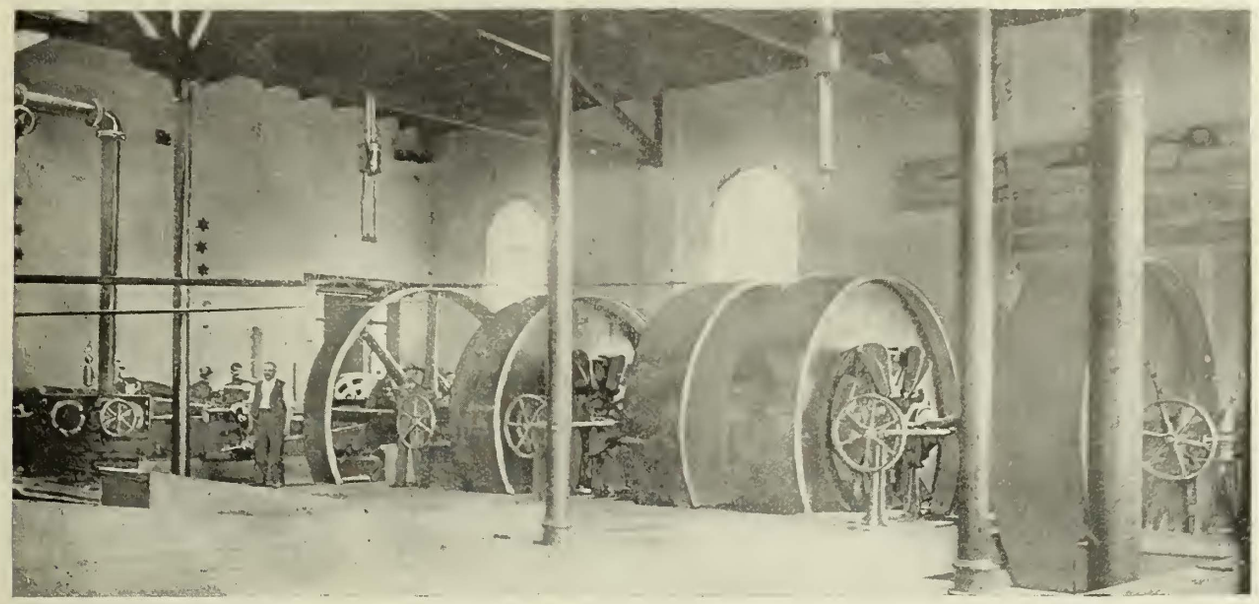


FIG. 4.—DRIVING SHAFT AND CLUTCH PULLEYS INSTALLED BY FALLS RIVET & MACHINE CO.—COLUMBUS POWER STATION.

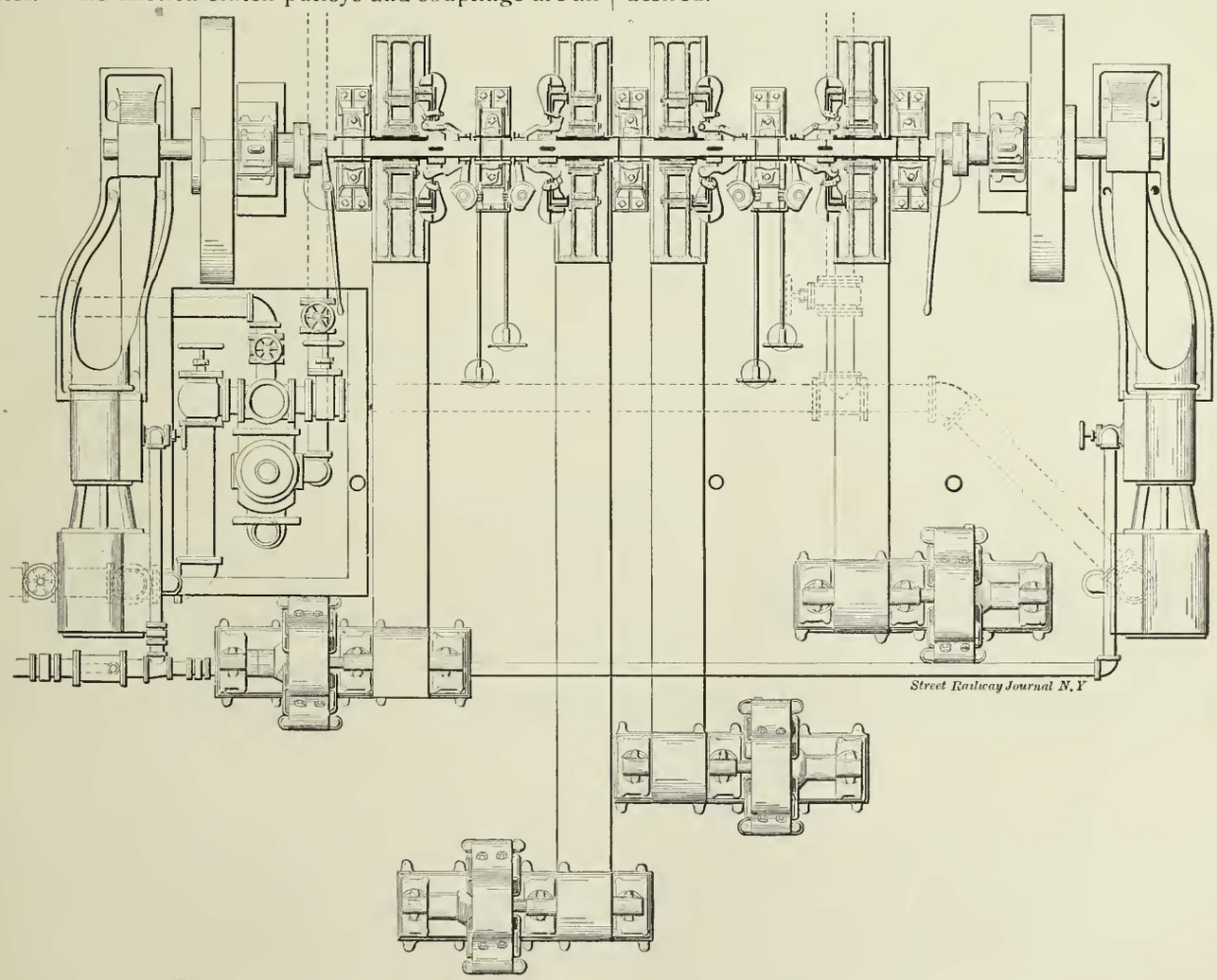


FIG. 5.—PLAN OF SLOW SPEED EQUIPMENT—COLUMBUS RAILWAY POWER STATION.

The engines are supplied with a Conover condenser. The four generators driven by the slow speed engines are also of the Thomson-Houston M. P. type and of 350 to 500 H. P. capacity each. Schieren belts are used throughout.

Compactness is a special feature claimed for the new portion of the plant, as the available space was the width of the building, sixty-five feet by fifty-five feet in length. At the same time there is ample room for passage ways around the engine and shafting and between the generators. The belts offer no obstruction, as the upper side of the belt is eight or ten feet above the floor, and the lower side, after passing through the floor, is neatly boxed, and except within a few feet of the generators the boxing is not so high above the floor as to prevent stepping over it.

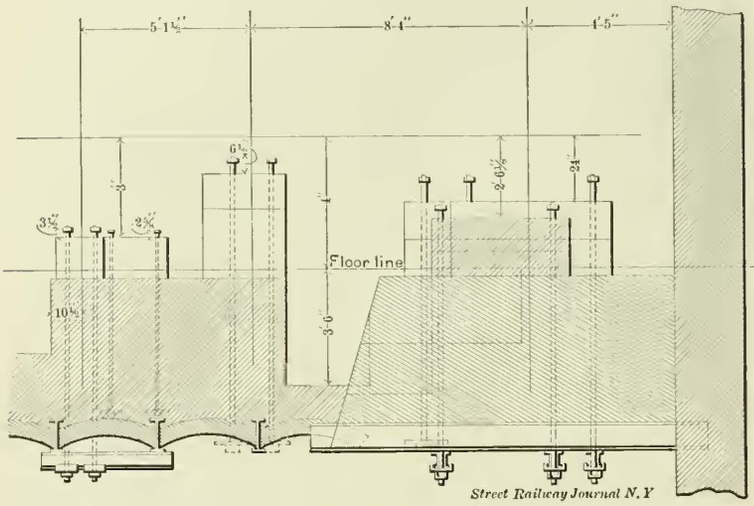


FIG. 6.—TRANSVERSE SECTION OF ENGINE FOUNDATION—COLUMBUS RAILWAY POWER STATION.

By this system either or both engines are available for driving a combination of any or all of the generators at one time, easily and conveniently meeting all the conditions of variable power occurring at different hours during the day.

Figs. 6 and 7 show the method employed in constructing the engine foundations. The building is located on made ground, the floor line being some twenty-two feet above the subsoil. It was the original intention to build up foundations for any engines which might be added, and sub-foundations for this purpose had been built of rubble work fourteen feet in height. It was decided, however, by the engineers in charge of the last installation that the walls of the building were of ample thickness and strength to carry a large percentage of the load of the foundations and machinery, so that it was determined to construct the foundation for the new plant on I beams with brick arches, supported partly by the walls and partly by the sub-foundations already in place.

The walls of the building were cut out for a depth of twelve inches on both sides and at the end, and the I beams at the building end were supported on steel plates twelve inches wide by eighteen inches long by one and one-eighth inches thick, the beams at the rubble work end being supported on plates of the same thickness, 18 × 24 ins., all substantially bedded in cement. The mason work is of select paving brick, all laid in German Portland cement with stone coping under the engines and pedestals supporting the shafting. The result is entirely satisfactory, as there is no vibration to foundations or building when the engines are in operation. Fig. 7 shows a side section of the engine foundation, and Fig. 6 an end section section of same with foundation of one shaft pedestal.

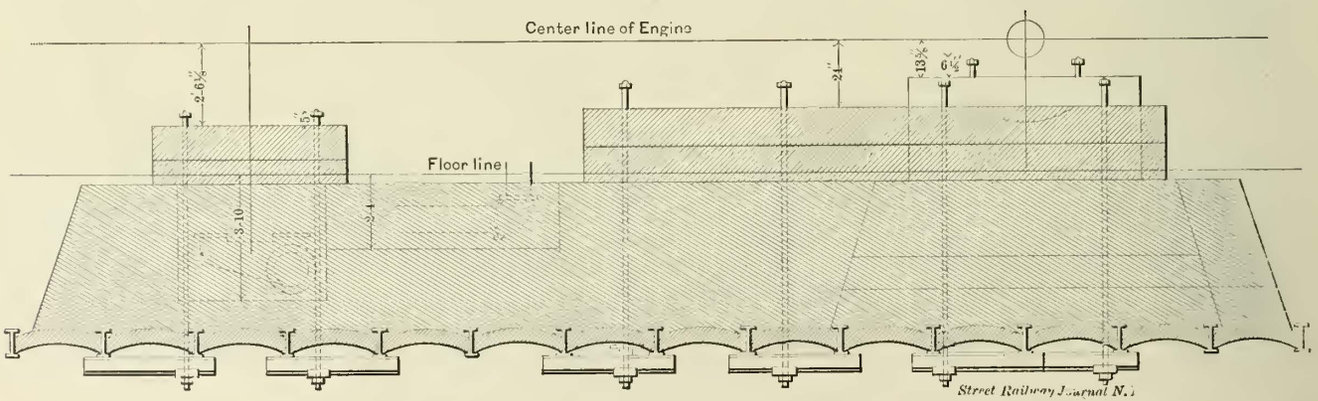


FIG. 7.—LONGITUDINAL SECTION OF ENGINE FOUNDATION—COLUMBUS RAILWAY POWER STATION.

The Botanical Garden Street Railway of Rio de Janeiro.

The Companhia Ferro Carril de Jardim Botanico has an exclusive franchise for one large section of the city of Rio de Janeiro, and it enjoys the distinction of being the best managed of any of the Rio street car companies.

In his last annual report the president of the company states: "The most notable event in the history of the company during the past year (1890) has been the extension of our franchise, granted by the City Council and approved by the minister of the interior in the name of the federal government in legal form, the papers bearing date of August 28, 1890. By this contract the Jardim Botanico Street Railway Co. secure an extension of franchise for forty years, dating from August 30, 1890. In return the Jardim Botanico Street Railway Co. agree: to pay at once, in cash, the sum of 1,500 contos of reis ($345,000); to pay an annual tax of 150 contos of reis ($34,500); at the end of this extension the entire property of the company shall revert to the municipality of Rio de Janeiro. Beyond these terms, the company agree to excavate a tunnel through Mount Copacabana, to construct some new and important lines, and to reduce the fares on some lines." The zone system of fares is in use.

The distribution of passengers as shown by the annual report was as follows: Number paying 100 reis (2.3 cents), 7,526,237; number paying 200 reis (4.6 cents), 4,991,749; number paying 250 reis (5.75 cents), 31,120; number paying 300 reis (6.9 cents), 208,130. The total receipts for the year were $444,524, and the total operating expenses, $206,103; number of cars, 107; number of mules, 1,399.

The cost of feed per animal per day was 12.31 cents, and the cost of taking care of each animal per day 5.21 cents.

A WRITER in a New York paper speaks of the curious conclusions sometimes drawn by foreigners. He mentions this incident: "I have in my possession a letter from a Chinaman, who asks me in all seriousness if the 'advertising cars run by electric power on the streets of St Louis, really do profit by the rabble who jump on them from time to time and ride a greater or lesser distance. My Chinese friend had seen the advertising wagons on the street, and had seen men carrying advertising placards day after day, and he naturally concluded the street cars, which are pasted over with advertisements inside and out, belonged to the same category. He thought people got into these cars to read the advertisements, and when he was asked for his fare he wrote me to know if it was a 'square deal.'"

Track Construction.

(*Continued.*)

From Advance Sheets of "Street Railways" (Trams).

By C. B. FAIRCHILD.

TIE RODS.

The importance of proper connections between the abutting ends of rails is recognized by all, but the value of cross connections is often overlooked. The pavement should not be depended upon for holding rails to gauge; this result should be secured by employment of suitable tie rods. Brace chairs may answer for low rails spiked directly to the ties, but for high rails, or where the rails are supported on chairs or stringers, it will be necessary to connect the rails to tie rods placed at frequent intervals. The spacing of tie rods will depend somewhat upon the height of the construction, but, ordinarily, they should not be placed more than four or five feet apart. They should be well made of heavy, flat, steel bars not less than one and a quarter inches wide, and from one-fourth to half an inch in thickness, with three-fourths of an inch round, threaded ends. Flat bars are more difficult to make than round bars, but they interfere less with the paving. Tie rods are preferably provided with two nuts at each end to facilitate adjustment, and jam nuts may be employed on the outer ends for additional security.

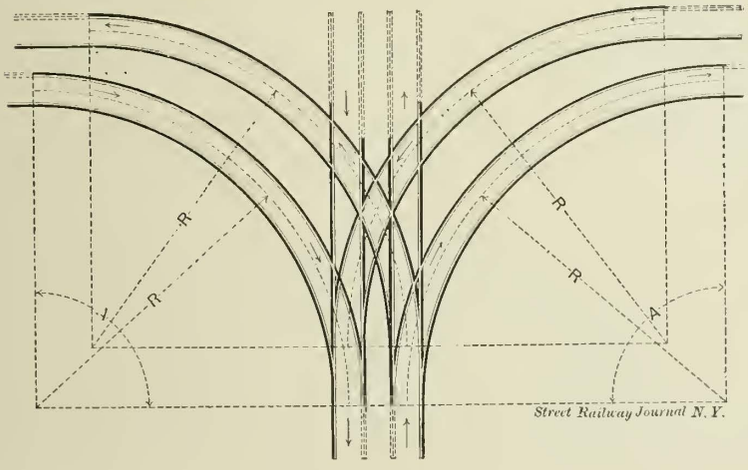


FIG. 1.—DOUBLE TRACK THROUGH Y CURVE.

SPECIAL CONSTRUCTION.

After a street railway is finished so far as it relates to the roadbed, ties, rails and joints. it is far from finished in regard to all the necessary requirements for successful operation. In fact, it may be said in some cases that it is only fairly commenced, for there is urgent necessity, even though the line contains but a single track for curves, switches, crossings, terminal and depot facilities, so that the original cost may be almost duplicated by the different classes of supplementary expenses, especially where intricate and involved construction is required.

It will be impossible to describe in this connection all the different features of special construction, for the conditions differ radically on different lines, and different types of rails have each a corresponding pattern for special work, so that while the different features are being constantly improved a favorite switch of one period is considered inferior to a new kind ; hence it will be necessary for the builder to refer to the illustrated catalogues of the rail makers for suggestive details, and in most cases the work of preparing and placing the material must be left in the hands of rail makers or others engaged in this special line of work.

There are some general requirements, however, that relate to this kind of work which service has developed that may be studied with profit. In the first place, it will be necessary to discard a good many notions and ideas that have formed the basis of practice with animal traction, for on mechanically propelled lines, and with electricity especially, the conditions are entirely different.

Attention has previously been called to the necessity of employing spiral transition curves in the survey, but this is useless unless the rails are laid accurately to the engineer's lines. Care must also be taken to place the connecting straight track at a perfect tangent to the initiatory curve, otherwise the car will lurch on entering or leaving the curve. The radius of a curve should not be less than thirty-five feet for cars with a six foot wheel base and double track curves leaving a double track should not be struck from the same centre (Fig. 1).

The inside curve may be made with the longest radius that conditions will allow and the outside with a radius that will not lessen the distance between the cars. Whatever the radius, the rails should first be bent to the proper arc, for if they are sprung into position after spiking one end the portions of the ends will be straight and the cars will suffer a shock at every joint. The outer rail of a curve may be elevated or not, depending upon the radius and local requirements. In some localities permission can not be had to elevate the rail.

Specially designed grooved rails are provided for use on curves with different track systems. One of those for the girder system is illustrated in Fig. 2; this is laid upon ties, chairs or stringers and properly braced.

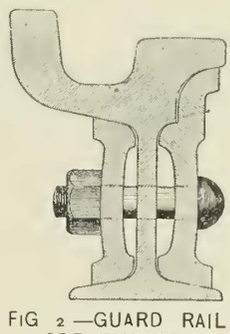


FIG 2.—GUARD RAIL FOR CURVES.

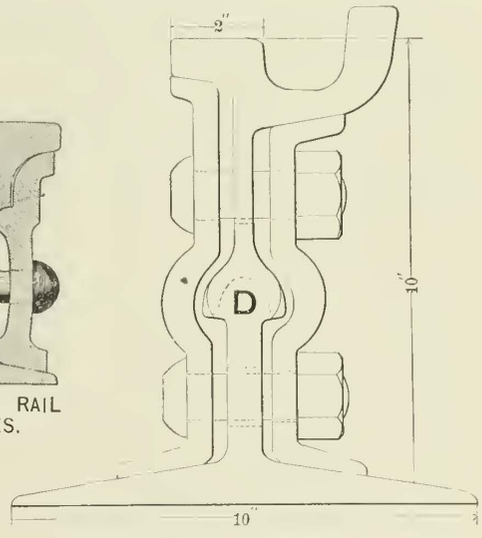


FIG. 3.—ELECTRIC GIRDER RAIL

Another design known as the "electric girder rail" for curves is shown in Fig. 3, in which the upper part down to the broken line D is continuous, and the foot is electrically welded to the rail at such intervals as correspond to the spacing of the ties.

Rails for curve construction are sometimes constructed with an adjustable guard so that when the guard is worn it may be removed and a new one substituted without disturbing the rail or foundation.

Turnouts for single track lines are preferably made equilateral or diamond shape (Fig. 4), and should not be made shorter than 250 ft., and the track should be a perfect tangent to the lead which should be formed at each end on a curve instead of an angle, and the switch pieces should be of sufficient length to allow of the curve being made with a long radius so that the cars may be run over them at a fair rate of speed.

Drop switches or blind switches are not suitable for electric lines, as it is frequently necessary to run in both directions. Cast iron switch pieces and frogs are being discarded, as those made of wrought iron or steel are considered preferable and are generally cheaper in the end. A construction known as "solid switch pieces" is being quite extensively employed for all special work, and consists of providing as a foundation pieces of open hearth steel, which are cast to proper dimensions and angles, and to which the steel guard rails are electrically welded, making a solid and durable construction.

In this connection a few illustrations of difficult construction are given (Figs. 5 and 6) as suggestive designs for curves, crossings and depot work. As a matter of history the ordinary stringer construction with tram rails for horse car lines is illustrated in Figs. 7 and 8. This style of construction, although unmechanical in that the expansion and wagon traffic soon loosen the fastenings, and the joint plates cut into the stringer, has served its purpose fairly well with animal traction, for repairs could be made without disturbing the pavement, but it is entirely unfit for mechanical traction, and it is a waste of money to build it. If a company contemplating electric traction cannot afford to put down a good track and roadbed they had better be content with animal power.

FIG 4.—DIAMOND TURNOUT.

PAVING.

The paving of the street between the rails and tracks is an important consideration in building and maintaining a line operated either by animal or mechanical power. This matter is usually regulated by local authorities, but it is important that street railway companies have some knowledge of the different materials and methods employed, for frequently they are able to use their influence to secure the adoption of a system of paving that is most desirable from the operator's point of view.

The essential requisites of a good street pavement, as stated by General Gilmore in his admirable "Manual of Roadmaking," are "that it shall be smooth and hard in order to promote easy draft; that it shall give a firm and secure foothold for animals, and not become polished and slippery from use; that it shall be as noiseless and as free from mud and dust as possible; also that it can be easily cleaned, and shall not absorb or retain surface liquids, but facilitate their prompt discharge into the side gutter catch basins. It should also be of such material and construction that it can be readily taken up in places and quickly and firmly relaid, so as to give easy access to water and gas pipes, and permit of being readily repaired at all seasons of the year."

Whatever the system of pavements adopted, it should be borne in mind that a good foundation is as necessary for its stability as that of any other construction.

Cobble Stones have been extensively employed in this country as a material for forming the path between the rails of such street car lines as were operated by animal power, and were generally considered the best because they offered a good footing for the horses and could be readily replaced after a street had been dug up, but they are not the safest or the best under mechanical traction, because the stones are liable to become loosened and roll under the wheels. Although entirely wanting in most of the essential requisites enumerated above, and possessing in nearly every particular features which a pavement should not have, doubtless cobble stone pavements will continue to be used to some extent in new towns and cities, and for this reason a brief description of the method of construction is given.

Cobble pavements are usually formed of rounded or egg shaped, hard pebbles, varying from six to ten inches, and in width from three to six inches. After the roadbed has been excavated they are set side by side in close contact with each other, with their smallest ends down, in a bed of clean, damp sand or small gravel from eight to ten inches in depth. After being set, the stones are firmly settled to their beds by a heavy rammer so as to bring their tops to the same surface, when a layer of gravel two or three inches thick is spread upon the surface and allowed to work its way in between the stones. Particular attention should be given to the selection of the gravel which should contain sufficient iron loam to insure cementing qualities.

Cobble stone pavements require constant repair, and should a stone work loose it should be immediately put back in place lest the adjoining stones become loosened, resulting in rapid depreciation.

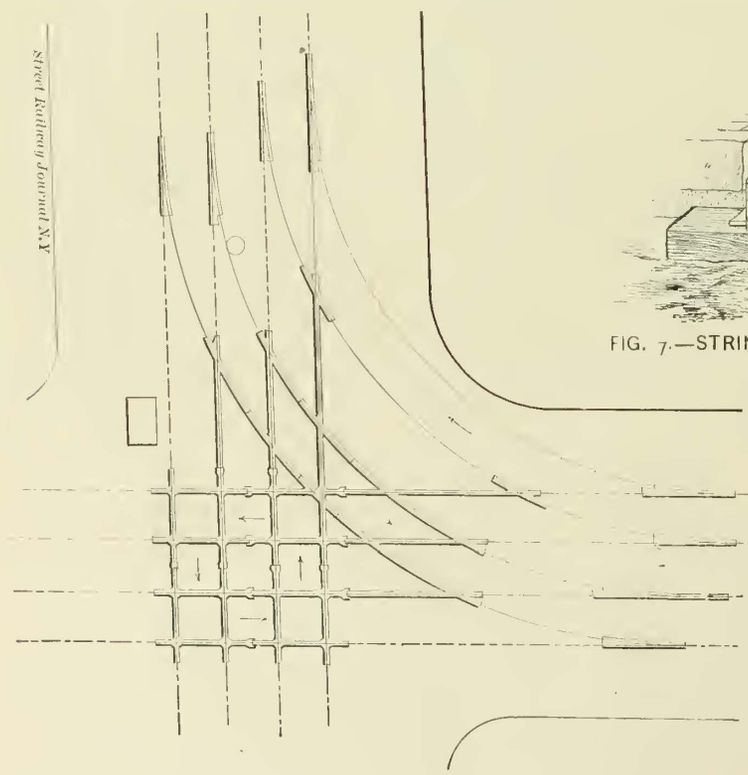


FIG 5.—DOUBLE TRACK CROSSING AND CURVE.

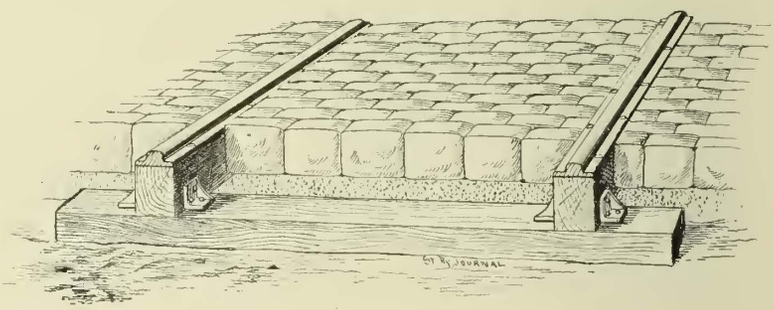


FIG. 7.—STRINGER CONSTRUCTION WITH CENTRE BEARING TRAM RAIL.

Stone Block paving is generally considered the most durable for heavy traffic. The material, or formation, should have the qualities of toughness, hardness and not be liable to become slippery. Granite, trap rock and sandstone formation are extensively used for this purpose. Granite is more satisfactory on some accounts, but trap rock is equally durable. The selection will depend largely on the supply to be had in different localities.

The size of the blocks should be proportioned to the number and weight of the vehicles which will pass over them. The standard dimensions for stone paving blocks in the vicinity of New York are three and a half to four and a half inches in width measured along the street, and from eight to twelve inches in length measured across the street, and seven to nine inches in vertical depth. Over rail ties and other places, blocks of less depth may be used, but the same general dimensions on the top surface should be maintained. It is important that the blocks on any one section be of uniform depth, so that when they finally settle to their beds the top of each surface will be on the same level. All the stones should be sound and of uniform quality as to hardness, color and grain; no outcrop, soft, brittle or laminated blocks should be used. It is also better, in case the material has been mined from different quarries, that the stones from each quarry should be piled and laid in separate sections of the work.

When the blocks of stone are nearly cubical in form, split as nearly as possible to right angles, with six inch faces, it is termed Belgian pavement, so named from its common use in Belgium. This so called Belgian pavement is falling into disuse in this country, however, for the reason that the blocks, being wide, provide a poor foothold for horses, the slip to strike a joint proving injurious.

The foundation for stone blocks may be formed of gravel, concrete or rubble stone grouted with concrete. The depth of the foundation should be proportioned to the amount of the anticipated traffic—not less than six inches in city streets—and whatever the material it should effectually cut off all connection between the subsoil and the bottom of the paving stone.

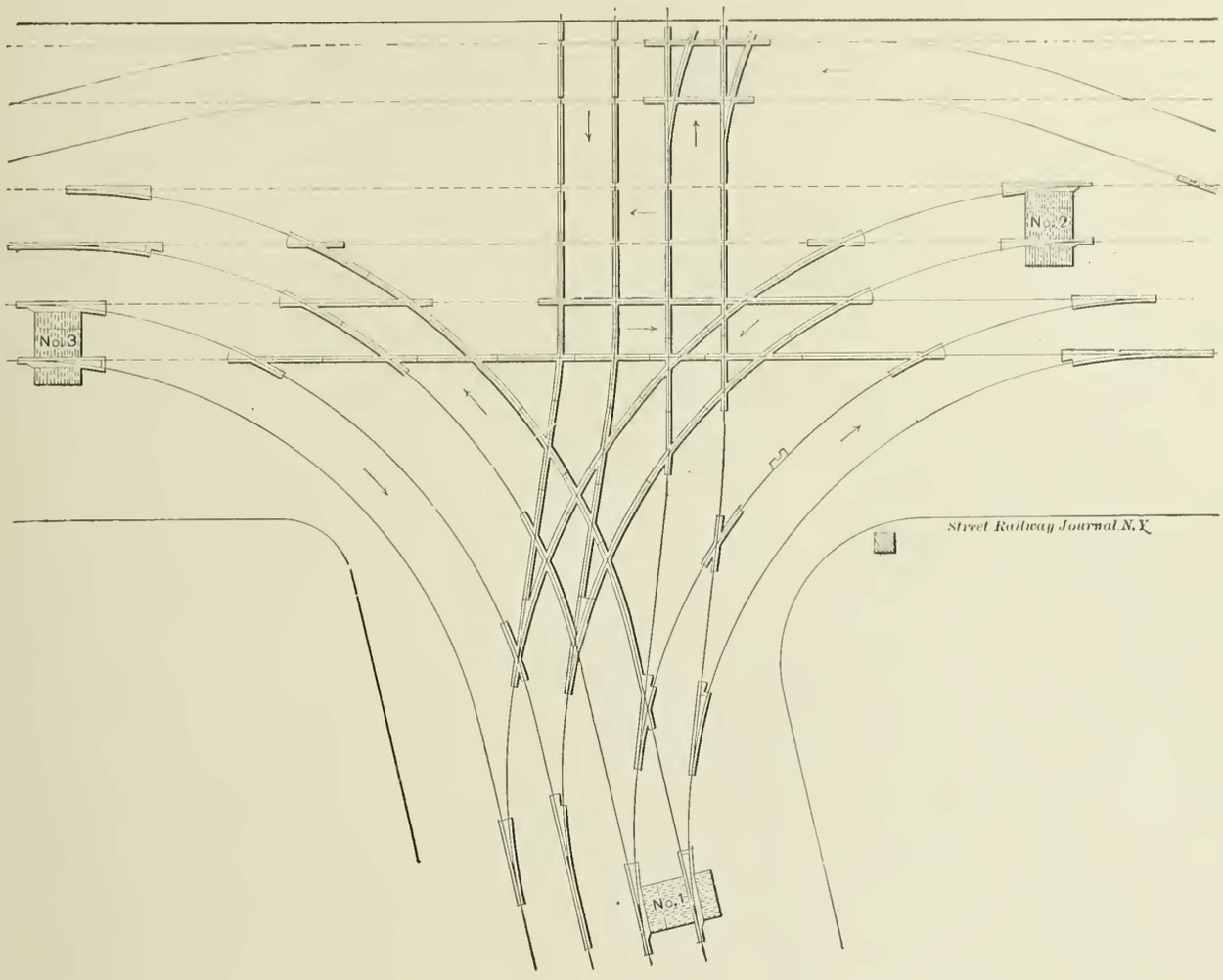


FIG 6.—DOUBLE TRACK TROUGH THREE PART Y CURVE WITH CROSSING.

In case a gravel foundation is to be employed, the roadbed should be carefully excavated to a uniform depth of from ten to thirteen inches, depending upon local requirements and the depth of paving blocks to be used, and all superfluous matter should be removed. Should rock or masonry be encountered it must be removed a little below the level of the foundation or subgrade. The foundation is then brought to an even surface conforming to the grade, and in case there should be found any spongy material or vegetable matter in the bed, it should be removed and the space filled with clean sand, and carefully rammed so as to make it compact and solid. The entire roadbed may then, if required, be rolled with a heavy (ten ton) steam roller until the surface is firm and compact. In case the steam roller cannot reach every part, the remaining portion may be tamped or rolled with a small roller. On this foundation should then be placed a layer of sand or fine gravel of sufficient depth.

In laying the pavement the stone blocks should be placed in courses at right angles with the line of the street, except at intersections of streets, and in other special cases, when the courses may be laid diagonally. On steep streets it is a good plan to lay the blocks in oblique course pointing up the grade and meeting at an angle in the centre. The channels thus formed by the continuous joints will facilitate the discharge of the surface water into the gutters (Fig. 9).

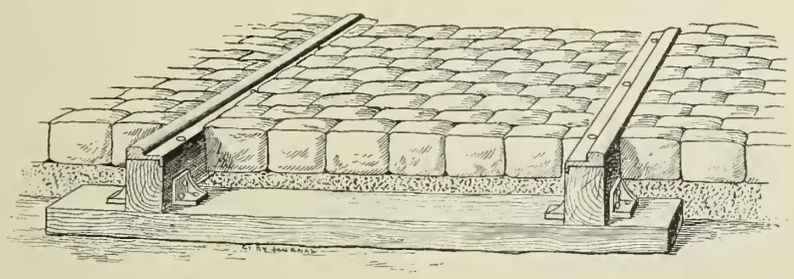


FIG. 8.—STRINGER CONSTRUCTION WITH SIDE BEARING TRAM RAIL

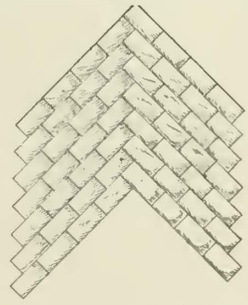


FIG. 9.—GRADE PAVING.

Each course of blocks should be of uniform width and depth and so laid that all end joints shall be close joints and broken by a lap not less than three inches. If the grouting is to be of sand, the joints between courses should be as close as possible, but if a grouting of mastic and gravel is to be employed, the joints between courses may be an inch or less. In case sand is to be employed, the blocks, on being laid, should be covered with clean, fine

sand, which should be carefully raked until the joints become filled, when the blocks should be thoroughly rammed to a firm, unyielding bed, with a uniform surface conforming nearly to the grade and crown of the street. When quite a section has been thus far completed it should be covered with a second coat of clean, sharp sand and receive a second ramming until the work becomes solid and secure. It is usual to employ one rammer to every two pavers.

A more durable paving is secured by providing a concrete foundation upon which to support the blocks, in which case the roadway should be excavated to a depth of sixteen inches below the top line of the proposed pavement, and carefully prepared as above described for a gravel foundation. Upon this foundation the concrete is placed to a depth of six inches, except over railroad ties, cable or electric conduits or other subway structures, when the depth may be increased, diminished or omitted as may be necessary.

In preparing concrete only fresh ground Portland, Rosendale or equally good hydraulic cement should be used. In case Portland is used the mixture may be made of one part by measure of cement, three parts of clean, sharp sand and seven parts of broken stone. With the Rosendale the proportions may be, by measure, one part cement, two parts sand and four parts broken stone. The mixture should be made in a suitable box or on a platform, and in no case upon the pavement or ground.

The sand and cement should be mixed dry, when water of sufficient quantity only to form a mortar is added; the broken stone, having been first wet, should then be added and the mass turned over and worked until the broken stone is completely covered with the mortar, when after being placed upon the prepared bed the concrete should be compacted with wooden rammers until it has a clear mortar surface, which should be at a uniform grade below the top of the finished pavement.

The broken stone should be sound and solid trap, limestone, or an equally durable formation, and of a size not larger in any dimension than will pass through a two inch ring, and should be carefully screened before using to free it from dust and dirt. The operation of mixing and laying the concrete should be performed as expeditiously as possible, and if necessary, protected from the action of the sun, wind or frost until set. None should be used which has been mixed more than three hours. The surface should be kept wet until covered with sand, and at least thirty-six hours should be allowed for the mixture to set before the paving blocks are laid. As the work progresses and connection is to be made with a section set or partially set, the edge of the section should first be broken down to free it from dust, when it should be wet in order to make the joint fresh and close.

Upon the foundation a layer of sand or cement mortar should be placed to provide a bed for the paving blocks. In case sand is used, it should be clean, sharp and perfectly free from moisture, and should be spread to a depth of not less than one and a half inches, or of a depth necessary to bring the blocks to a proper grade when thoroughly rammed.

In some cases, especially between the rails and tracks of a cable line, it is desirable to employ cement mortar as a binding material for the blocks. A mixture of sand and cement is spread upon the foundation, and into this soft mass the blocks are pressed to a proper level and left till the mortar is set. The joints may then be filled with a grouting of the same material.

The more general practice, however, provides a bed of sand on which to rest the blocks, and the grouting consists of gravel and a mastic cement. The stone blocks being laid in courses as above described, with the joints between courses not more than one inch top and bottom, are then covered with clean, hard, hot, dry gravel, of such a size as will pass through a sieve of three-quarters of an inch mesh and be retained by a quarter inch mesh, and then brushed into the joints until they become filled, when the blocks should be thoroughly rammed, and then more hot gravel applied and again rammed and the process repeated until the joints are full and the blocks are brought to an unyielding bearing with a uniform surface, true to the roadway on the established grade.

A portion of the gravel at the top of the joints is then raked out to the depth of about two inches, when the paving cement, or mastic, should be applied while the gravel is still hot. The mastic to be employed for filling the joints may be of coal tar or asphalt, or a combination of the two In case coal tar alone is used in cold climates it is apt to become so hard and brittle in winter as to crumble from the vibration of the blocks. On the other hand, if clear asphalt is used, it deteriorates after a time and crumbles, and does not maintain a watertight joint. The following combination, however, has given good results, and is recommended: A cement composed of twenty parts of refined Trinidad asphalt and three parts of residuum oil mixed with 100 parts of No. 4 coal tar. Suitable cauldrons being provided on the work, the mixture is heated to a temperature of 300 degs. Fah., and while still boiling should be poured into the joints until all the interstices of gravel are filled, and the joints are filled flush with the top of the blocks. Dry, hot gravel of proper size, having previously been heated in pans provided for the purpose, should then be spread along the joints and bedded into the cement by tamping with a light rammer or other instrument.

The durability of the pavement depends, in a great measure, on the gravel filling. The cement and mastic filling not only assist in holding the blocks in place, but, being impervious to water, they prevent the entrance of moisture, which would tend to soften the foundation and cause the blocks to settle unevenly, or when frozen heave them from their beds. The importance of excluding moisture from paving foundations on cable lines has been noted in the second chapter. It prevents freezing and consequent slot closure.

Besides providing paving blocks of suitable quality and dimensions, attention should also be given to the quality and dimensions of the bridge or crosswalk stones, the manhole heads and the curb and gutter stones.

The North River bluestone or granite, free from seams or imperfections, is regarded as excellent formation for these purposes, and whatever material is used it should be equal in quality to these. The dimensions of the bridge stones should not be less than four or more than eight feet, long except in special cases, and two feet wide and of a uniform thickness, which may vary in individual blocks from six to eight inches. They should be dressed on the top so as not to vary in evenness by more than a quarter of an inch, with sides and ends cut square to the full depth and the ends cut to a bevel of six inches in two feet in order to provide a diagonal joint, which will prevent wheel gutters being formed at the joint as is the case when the joints run parallel with the street. The bridge stones should be firmly bedded on a foundation of clean, sharp sand, and be tamped in such a manner as to admit of no further settlement. In some cases a row of paving blocks is laid between the courses of bridge stones, in which case the joints should be filled in the same manner as the joints of the adjacent pavment.

The dimensions of the curb stones should be not less than three feet in length, five inches thick and twenty to twenty-five inches deep. The top should be cut to a bevel of one inch, the front cut smooth to a depth of fourteen inches, and the ends truly squared. When in place they should be backed up by at least a foot of clean, gritty earth, free from clay and loam. The frames and heads for the sewer and water manholes should be cut to the required dimensions.

Asphalt, in some of its various forms, is rapidly growing in favor as a paving material in those sections of the country where the climatic conditions are favorable. There is some objection to asphalt as a pavement between street car tracks where the lines are operated by horses, on account of its slipperiness and the difficulty of getting at the foundations for repairs; with mechanical traction, however, and a substantial roadbed, these objections are obviated.

The use of this material obviates the intolerable noise which is a necessary accompaniment of stone pave-

ments, and, being a non-absorbent, it is, for sanitary reasons, a most excellent pavement. As formerly constructed, horses were liable to slip on it in wet weather, but this defect has been remedied in a measure, and animals on becoming accustomed to it do not slip to any great extent. The surface being slightly elastic, the limbs of horses receive less shock than when driven on a hard surface, and the animals generally keep in better condition, both for this cause and because, being smooth, there is little resistance to draft.

Asphaltum is known as bitumen and mineral pitch. There are two forms in which the material is used as a pavement, and a capital distinction should be made between them. One is pure asphalt which is of the consistency of rosin, is black like coal and burns more freely than coal. The other is rock asphalt, and consists of shellstone, sandstone or limestone impregnated with from 8 to 20 per cent. of bitumen.

Pure asphalt is obtained in great quantities from or near a lake in the district of La Brea on the island of Trinidad, one of the West India islands. Some interesting particulars relating to the mining of asphalt in Trinidad, are found in the article on "Asphalt: Where and How Mined," in another part of this issue.

The natural asphalt rock is mined at Seyssel, France; Val de Travers, Switzerland; Ver Wöhle, Germany and other foreign countries, and in this country in Southern California and Kentucky. The foreign varieties are generally of limestone formation, but so far the discoveries in this country are of sandstone formation. The deposits in California seem to have been formed of a loose mound of sand saturated with bitumen, as the ultimate particles are found to be rounded as if by the action of water, but the Kentucky variety is a black sandstone in character, the particles being of a true sand crystal structure, sharp, gritty and flinty. It seems to have been impregnated with the bitumen under heat and great pressure, and is found in veins or strata of various thicknesses, from nineteen to sixty feet. The natural rock asphalt, when it contains from 9 to 12 per cent. of bitumen, does not require to be mixed with any other substance for forming pavements. The rock is crushed or powdered and then placed in portable heaters and raised to a temperature of from 200 to 250 degs., which softens the bitumen; and while still hot it is spread over the foundations and powerfully compressed by ramming, tamping or rolling with hot iron tools, so that the molecules unite, and the mass when cold assumes the essential qualities of the original rock. The imported varieties are considered best, although very good results are had with some of the native material, especially with that found on the Pacific Coast, many of the street car lines in San Francisco being paved with it.

Trinidad asphalt is not suitable by itself for paving purposes, but it is first mixed with sand, powdered carbonate of lime and petroleum oil in certain proportions which have been determined from long experience and careful observation to be the best. The mixture may be varied to suit the varying conditions of climate and traffic. The materials are mixed together at a high temperature in suitable cauldrons, and while still hot spread two or three inches thick over a concrete or other foundation by means of iron rakes, and then thoroughly compressed by a heavy roller.

The concrete foundations for asphalt pavement may be formed in about the same manner as above described for stone blocks; but the best results are obtained by spreading the wearing surface or paving proper upon an existing stone block or macadam pavement. In this case the surface should be thoroughly swept and cleaned with stiff brooms and the joint filling removed to a depth of two inches. A binder coat of bituminuous concrete should then be spread over the blocks, filling all depressions and bringing the surface to a uniform grade and cross section. The stones composing the binder coat should not be more than one and a quarter inches in their largest dimensions, and, having been heated in revolving ovens, should be mixed by machinery with a coal tar residuum known as No. 4 paving mixture, in the proportion of one gallon of coal tar to one cubic foot of stone, and then spread with hot iron rakes to such thickness that, after having been thoroughly compacted by tamping and hand rolling, the thickening of the binder at any point will not be less than three-quarters of an inch. It will be found of advantage to provide a binding coat, as above described, with any foundation, be it concrete or old paving, as it tends to prevent the wearing surface from crawling and buckling, a defect that is sometimes observed in asphalt pavements.

The foundation having been thus prepared, the wearing surface may be prepared and laid as follows, the method being about the same as that required for this class of pavements in the city of New York:

First, an asphaltic cement is manufactured, which is composed of pure refined pitch, (lake asphaltum) and petroleum oil, having a specific gravity of from eighteen to twenty degrees Beaumé, mixed in the proportion of 100 parts of the asphaltum and from fifteen to twenty parts of the oil. The cement having been prepared, the paving mixture is formed of the following materials and indicated proportions:

Asphalt cement from twelve to fifteen parts.

Fine sand from seventy to eighty-three parts.

Pulverized carbonate of lime from five to fifteen parts.

The sand and asphalt cement are heated separately in suitable apparatus to about 300 degs. Fah. The carbonate of lime, while cold is mixed with hot sand, and then both are combined with the asphaltic cement at the required temperature. The mixture is then brought to the ground, and while at a temperature of not less than 250 degs. is carefully spread by means of hot iron rakes to such a depth that after being compressed it will have a thickness of two inches. The surface is then compressed by means of hand rollers, after which a small amount of hydraulic cement is swept over it, when it is thoroughly compressed by means of a heavy steam roller, the operation to continue for not less than five hours for every 1,000 yds., of surface.

In order to make the gutters entirely impervious to water, it is recommended that a width of one foot next the curb be coated with hot, pure asphalt and smoothed with hot smoothing irons so that the pavement at this point shall be saturated with an excess of asphalt.

In case rock asphalt is to be used, it is customary to specify that it shall be a mixture of material from the Sicilian and German mines or other mixtures of equal quality, which, ground to a fine powder containing from 9 to 12 per cent. of natural bitumen, with from 88 to 91 per cent. of pure carbonate of lime and free from quartz sulphates, iron pyrites or aluminum, shall be laid without any additions whatever. The process of preparing the powder consists of heating it in a suitable apparatus to 200 or 250 degs, and spreading and compressing it, in the same manner as described for the asphalt mixture, to such a depth that after having received its ultimate compression it will have a thickness of two and a half inches, the surface to be rendered perfectly even by heated smoothers, when it is to be sprinkled with clean, sharp sand. For the reason that the pavements constructed of rock asphalt do not obtain their ultimate compression from traffic for a longer period than that required for the Trinidad pavement, it is recommended that the former be laid to the depth of two and a half inches.

The Trinidad pavements do not become so slippery in wet weather as the European rock ashphalt pavements, and offer a better footing for horses, for the reason that the body is composed of sharp sand, while the body of the latter is a smooth, impalpable limestone. There is but little difference in this respect, however, between the pure asphalt and the native rock varieties, for, as stated previously, the particles of the body of the native varieties are sand.

In joining asphalt pavement to track rails it is customary in some localities to place a row of paving blocks as headers (long and short stones alternating and toothing into the pavement) on each side of the rails to absorb the vibrations of the rail and provide a track for

street vehicles. In practice it is found better to provide a concrete foundation for the blocks, whatever be the foundation for the pavement proper.

Asphalt is also wrought into blocks or bricks and laid in about the same manner as stone blocks. In this form it is principally employed for sidewalks or for footpaths in parks and commons, but has been employed for street pavements in Washington and Baltimore to a considerable extent. While apparently giving satisfaction, these pavements have not been in service long enough to test their duraability.

Blocks of Wood, set on the end of the grain, have been extensively employed as a paving material in this country and elsewhere for a number of years. The original type of wood pavement is the Nicholson, named after the inventor, in which blocks of yellow or white pine were employed, usually about four inches wide and from four to sixteen inches long and six inches deep. The method of construction consisted in excavating the street to a depth of nine inches, and placing a foundation of clean sand, upon which a flooring of tarred or creosoted pine boards one or two inches thick was placed. Upon this flooring the blocks were set in parallel courses running across the street, the courses being separated from each other by thin battens of pine, and the spaces filled with a mixture of sand, gravel, coal tar or their equivalent.

Nicholson's method has been greatly improved, and in fact is not used in the best European practice, especially as to foundation and the use of battens for separating the blocks. The only successful practice consists in providing a concrete foundation, and placing the blocks close together. Besides pine, chestnut, cedar, red wood, eucalyptus and some other kinds of wood are used, depending upon the supply to be had in any locality. Blocks, hexagonal in shape, possess many advantages, but round, conical and rectangular in shape are also employed, which are laid with various combinations of concrete, tar, asphalt and gravel. To prevent decay, the blocks are frequently creosoted or impregnated with various chemical preservatives. Wood pavements are apt to be slippery in wet weather, and are very perishable, both from wear and from decay, and are objectionable, for sanitary reasons, as the blocks absorb the surface liquids and at times give off offensive odors.

Wood blocks are cheaper in their first cost than granite, and in certain localities are necessarily employed because other material is not to be had except at great cost, and notwithstanding the above objections, they have a number of points of excellence to recommend them when new, among which are ease of draft and noiselessness, are easily kept clean, produce less shock to the limbs of horses, lessen the wear of vehicles and admit of high speed, and smooth passage.

As before noted in the second chapter, this type of pavement is not suitable for use for paving the tracks of cable lines, as the swelling of the material from moisture tends to slot closure.

Wood pavements will be found to be a very expensive luxury when laid on streets subject to excessive traffic. Their success abroad is due not only to their expensive construction and careful and costly maintenance, but also to favorable conditions which do not exist in the cities of this country. Among those conditions are the regulations requiring that the wheels of all vehicles be provided with wide tires and that the horses be shod with smooth shoes without calks.

Vitrified Brick made from a peculiar clay is being extensively employed as a paving material in the cities of Ohio and other Western cities, and is regarded with considerable favor. The material is ground fine and then moulded under heavy pressure to the same form and with about the same dimensions as ordinary brick, when it is vitrified by burning so that it will not absorb moisture.

Some manufacturers form the brick with parallel grooves extending around sides and ends (Fig. 10), which become filled when the joints are grouted and serve as a lock to hold the block in place and prevent its being forced up by sub-pressure. The bricks are usually formed with rounded corners on the top to provide a sure footing for horses, and are set on edge on a foundation of concrete or broken stone, with a cushion of sand. The grouting consists of sand, or, preferably, of mastic cement.

Brick pavements have long been in use in Holland where they have proved to be very durable, but, it is

FIG. 10.—VITRIFIED PAVING BRICK.

claimed by the new process of manufacture, that a superior paving brick, equal to stone and of uniform size is produced, which has the advantage of being less noisy than stone and more economical. The use of this material thus far in this country has been limited to streets subject to a comparatively light travel, but the manufacturers claim that they are strong enough to withstand the heavy traffic of our large cities.

Broken Stone is extensively employed for roadmaking, and although it may not be strictly regarded as a paving material, the leading systems of stone roads are admirably adapted for suburban lines and streets in small towns, while they are undesirable for large cities.

Two leading methods are employed for making stone roads, known as the macadam and telford systems. The first is constructed by placing successive layers of broken stone directly upon the soil, so that they form a crust on the surface, producing a durable roadway, and which retains the name of the inventor, McAdam.

Roads made with layers of broken stone resting upon a sub-pavement of stone blocks or ballasting, are called telford roads after Thomas Telford, by whom they were first constructed in Great Britain. The advantages and disadvantages of the "bottoming" which forms the chief difference between the two systems have been the subject of lengthy disscussions between their respective advocates. The character of the soil, whether wet or dry, would seem to determine a choice between the two methods, although the latter can doubtless be built somewhat cheaper, for the foundation stones may be of an inferior quality and the labor of breaking them avoided. Of late years little distinction is made between the two systems, and the term "telford" is frequently applied to the foundation of macadam roads. In preparing for the foundation, the surface, subsoil and other matters should be removed to the proper depth and the bed should be rolled, shaped and trimmed to the required grade in the same manner as described for stone block paving. The foundation stones should then be set close together with their longest sides parallel to the curb, and then firmly wedged by inserting and driving down with a bar in all possible places between them, stones of the same quality. All projections and irregularities should then be broken off with a hammer, care being taken not to loosen the stones, and the chips should be worked and driven with the hammer into all the interstices not already filled by the process of wedging, so that the foundation when completed shall present an even but not too smooth surface and be about eight inches thick under the macadam. The material for the macadam should be hard and tough. The most useful are the basaltic and trap rock formations, while certain classes of green stones—selenitic granite—are good, as are also the boulders and pebbles of tide water regions. The stones should be broken into pieces not larger than will pass through a ring of two and a half inches in diameter, and then spread (on a dry day) over the bed, the first coat being not over three inches thick and entirely free from earthy mixture. This is then compacted by admitting the travel upon it, or better, by a heavy roller, men being stationed to rake down any ridges that may be formed. When sufficiently consolidated, a second coat of three inches is added, when moisture may be introduced, which will greatly facilitate the union of the two courses. A third coat is added as was the second, and a

fourth if necessary. To hasten the smoothness, an inch of gravel or finely crushed stone may be spread over the surface and be passed over by the roller. The stones being properly placed, combine by their own angles, and after a few years adhere together in a smooth, solid surface which is not likely to be affected by the weather or displaced by frost.

It will be difficult to construct a satisfactory macadam pavement on street car lines where tie rods are employed in the construction, as these interfere with a proper bonding of the material. On lines with very heavy traffic it is also difficult to maintain this class of paving in good condition. In any event, roads of this kind need careful attention. The wear of the material, whether mud or dust, thould be continually removed and replaced by new materials. A road treated in this manner will need no repairs, as such ; but if put in order only at intervals it will need serious repairs

COST OF CONSTRUCTING PAVEMENTS.

The present contract price for paving the streets of New York, including the curb and bridge stones, is about as follows :

For granite blocks on gravel foundation $2.80 per square yard.

For granite on concrete foundation $3.60 per square yard.

For asphalt (either Trinidad or rock) on concrete base, with a five year guarantee, $3.00 per square yard.

For asphalt on concrete base, with a fifteen year guarantee, $3.80 per square yard.

For asphalt on an existing stone pavement as a base, with a fifteen year guarantee, $3.40 per square yard.

Vitrified brick pavements on broken stone foundations cost in the vicinity of the manufactories about $2.15 per square yard.

Wood pavings cost usually about $1.25 to $1.50 per square yard.

The cost of cobble paving is generally from $1.90 to $2.10 per square yard.

CEMENT.

For the reason that cement constitutes an important element in the construction of paving foundations and cable conduits, and is also used as grouting and for other purposes, it is as important that some knowledge of its nature and manufacture be had as an aid in selecting the best brands as it is to know the particulars regarding other materials, such as stone and asphalt.

The first natural cement known to commerce was produced in England in 1796, in an attempt to imitate the Roman cement which has given to the ancient works of the Romans their lasting character ; hence, when a cement was produced that, when mixed with sand, would harden under water, the name "Roman cement" was given to it, and the material resembled closely the Rosendale and other natural cements now manufactured in this country. The process of manufacture, as now adopted in this counis a very simple one, and consists in quarrying argillaceous limetones or dolomites containing certain percentages of lime, magnesia, silica and aluminum ; calcining the broken rocks in open kilns with coal at a light heat and drawing the calcined product continuously from the kilns and grinding it between millstones. The resultant powder is barreled or put in sacks and becomes the ordinary light burnt, natural, hydraulic cement of commerce.

The first commercial Portland cement of commerce was produced in England in 1824, and was made by combining the English chalks with clay from the river, drying the mixed paste in the form of bricks, eggs or balls and calcining at a high heat the material thus produced. The calcination was done in closed kilns, and the product was a clinker, which when ground formed a cement of great strength and hydraulic character, to which the name of "Portland cement" was given, because the stone it produced, when used in concrete, resembled in color the well known "Portland" building stone of England. Portland cement differs from the natural light burnt, hydraulic cement in that it is an artificial product wherein the proportions of lime, silica and aluminum are combined in uniform proportions, and the material that is calcined in a kiln becomes a new rock or stone artificially produced by the mechanical mixing of the clay or lime, or of the natural rock composing it, so that chemical action necessary for the production of the highest grade cement can take place under the most favorable circumstances. In the natural cement the rock is taken in the condition that Nature has given it, and the calcination is at a low temperature, so that a large percentage of the material is inert and has no value of a cementing character ; while in the Portland cement, burnt at a high heat, all the elements are active.

Knowing, therefore, the facts governing the production of hydraulic cement, one is able to determine which is best for a particular work. It must not be inferred, however, that the manufacture of Portland cement is confined to foreign localities, for while the development in the manufacture of the cheaper grades of cement in this country has been going on very rapidly, the development of the Portland cement industry has received a great deal of attention, so that the ingredients of the product and method of manufacture are no longer shrouded with an air of mystery, but the American cement companies have demonstrated their ability to make, by improved processes, a Portland cement, equal to the best foreign grades, out of natural rocks, and also out of marls and clays which are the chemical equivalents of the chalk and clay of England.

While the consumer should make a capital distinction between Portland and natural cement, he need make no distinction between American and imported Portland except in regard to price. The purchase of cement of whatever brand should be on condition that it be subject to the practical tests which are usually employed by engineers and architects in the purchase of cement. As previously stated, cements are usually shipped in barrels or bags. In case, however, the material is to be delivered and stored along the work before it is used, it is better to stipulate that it be shipped in coopered barrels, and after being in position it should be carefully sheltered from storms ; and in no case should the barrels be allowed to rest directly on the ground or upon sidewalks, but should be blocked up by suitable underpinning.

West Side Cable Power Station, Chicago.

The engine capacity of the power station of the West Chicago Railway Co., at the corner of Washington and Jefferson Streets is to be doubled. The 500 H. P. engines have been removed, and a pair of engines, capable of developing 1,000 H. P. each is now being erected. The cylinders are 36 x 60 ins., and the engines are of the make of Fraser & Chalmers of Chicago. Rope transmission is employed, as in the previous installation. A six foot rope sheave is located on the engine shaft, which will drive, by means of twenty-four single ropes, a twenty-eight foot rope wheel. It is expected that the plant will be ready for operation during the first week of the present month. The load which was carried by this station has been shifted to the new smaller power house in the adjoining building where a 500 H. P. engine, built by the Corliss Engine Co. of Providence, R. I., is in operation.

THE engineer of one of the Chicago cable street railroads recently made the following statement to a newspaper man : "We have found that the power required for the operation of the system on rainy days, when the tracks were wet, was fully 20 per cent. less than on dry days, and at the same time we estimated that at least 25 per cent. more passengers were carried at such times. This gives a very large showing in favor of wet rails where cable power is used, and the adhesion between wheel and rail is not depended upon for traction. With a steam locomotive or an electric motor the result is just the reverse, for with them the slippage is excessive when the rails are wet. Under these circumstances rainy days are a greater blessing to the cable roads than is generally supposed."

Notes from the Field.

Lawrence, Mass.

One of the most successful among the smaller roads of New England is the Merrimack Valley Street Railway which connects the towns of Methuen, Lawrence, South Lawrence and Andover. The cars on this road were operated by horse power until about March, 1891, when the road changed hands, and Mr. J. N. Beckley, of Rochester, was elected president, and at that time the road was equipped with electric power, the motors selected being those manufactured by the Detroit Electrical Works.

The length of line at present is fifteen miles, but the contracts have been signed for the construction of a one and a half mile extension. For ease in operating cars the line is divided into four sections, the cars on each section being distinguished by color as well as by the lettering and the signs they carry.

The track is laid with forty-five pound tram rail, forty pound T rail and forty-five pound Johnson girder rail, the latter being the type employed on all the recent work, with the exception of about one mile where a T rail was laid. The girder rail is mounted in chairs on ties, and the track is block paved, a double joint chair and angle splice bars being used at the joints. With the tram rail the joints rest on a twenty-seven pound joint plate with a lip on each side. The T rail when paved to is on chairs, with tie rods and splice bars at joints. All the T rail was supplied by the Pennsylvania Steel Co. The rails are double bonded for a return circuit, the resistance being further reduced in the case of the tram rails by the use of a supplementary wire. Galvanized iron rail bonds are used.

DETROIT MOTOR CAR ON 10 PER CENT. GRADE—LAWRENCE.

The overhead wires are supported upon side poles. Iron tubular poles are used for about two miles, the rest being equipped with sawed wooden poles. The points at which the cars will stop to receive or discharge passengers are indicated by a white band painted about the railway poles on each side of the street at a distance of about ten feet from the ground.

As the grades on the line are many and severe, notably on the North Andover division, the satisfactory service of the electric apparatus is especially worthy of remark. One loaded trail car is often drawn by one motor car up the long 9 per cent. grade in Andover and upon other parts of the line. Fig. 1 shows a Detroit car mounting a 10 per cent. grade on the Methuen division.

The rolling stock of the company consists of three snow plows and forty-eight cars, of which nineteen are motor cars and twenty nine trail cars. Fifteen of the motor cars are equipped with the Detroit system, using one motor on the car, geared to both axles, and four are equipped with Thomson-Houston S. R. G. motors. McGuire trucks are used with the Detroit equipments, and the motor car bodies and the trail cars were manufactured by the Ellis Car Co., Lewis & Fowler, Jones' Sons and the Newburyport Car Manufacturing Co. The cars are equipped with Lewis & Fowler registers, and the rack advertisements are supplied by Carleton & Kissam.

The three snow plows were made by the Newburyport Car Manufacturing Co., and are equipped with Thomson-Houston motors mounted on the platform and connected by sprocket chains with the car axles.

The power house of the Merrimack Valley Street Railway Co. is a substantial brick building near the eastern terminus of the road, and is on the banks of a stream, so that an ample supply of water for condensing and and other purposes is available. The tracks of the Boston & Maine Railroad are directly in the rear of the station, and a siding from these has been laid so that coal is delivered from the railroad car directly in front of the boilers. The boiler room is forty-two feet wide and forty-three feet long, and is separated from the engine room by a brick fire wall. The boiler plant consists of two batteries of Babcock & Wilcox boilers, their total capacity being 480 H. P. These are provided with two Worthington independent jet condensers, taking water from a distance of sixty feet horizontally, with twenty-one feet lift. The feed pumps are of the Worthington duplex pattern, and the heater is of the Wainwright type

The engine room is forty-seven feet wide and sixty-six feet long, and contains three engines of the McIntosh & Seymour tandem, compound condensing type. Two of these have cylinders 13 and 23 × 17 ins., and are of 250 H. P. each, and the third has cylinders 11 and 19 × 15 ins., and is of 150 H. P. These engines are direct belted by Schieren belts to five M. P., eighty K. W., Thomson-Houston generators.

The steam pipe to each engine is fitted with a Robertson separator. There is also a combined pump and receiver, which drains the water of condensation from the live steam pipes, and from the engine cylinder jackets and receiver, forcing this water directly into the boilers at nearly a boiling temperature.

The exhaust steam from all condensers and feed pumps is discharged into the heater. The live steam pipe system throughout is thoroughly drained and provided with independent valves for each boiler and each engine, thus making the plant perfectly flexible, and enabling the engineer instantly to throw out or into commission any boiler or any engine. Magnesia sectional coverings are used.

Each engine exhaust is furnished with a shut-off valve, placed near the main steam heater, running to the condenser, and in addition to the main exhaust each engine is fitted with an exhaust pipe opening into the atmosphere, this atmospheric pipe fitted with a Wheeler automatic atmospheric valve. This device enables the engineer to start any of the engines working until such time as the engine is well loaded and warmed up in perfect working order. By opening the valve in the exhaust to the condenser the engine is at once closed to the atmosphere.

The steam gauge in use was made by the Crosby Steam Gauge & Valve Co. of Boston, and the vacuum gauge by the Ashcroft Manufacturing Co. of New York and Bridgeport. In the engine room is also an automatic damper regulator operated by the steam pressure, manufactured by Locke & Bros. of Salem. Vacuum oil is used, filtered by the Purity Oil filter, the supply being kept in a special cabinet manufactured by the American Oil Cabinet Co. of Boston.

The switchboard, which is also in the engine room, is of wood, open framework style, and with switches, regulators, etc. of the standard Thomson-Houston pattern. Simplex wire is used for wiring to the switchboard and for feeders.

The engine and boiler plants have recently been increased to the extent of 250 H. P., which it is believed will handle any future increase in load.

Pierce & Thomas, engineers and contractors, 42 Cortlandt Street, New York City, did the engineering and executed the contract for the complete steam plant, installed and turned it over running. Since its installation it has operated with eminent satisfaction and success under a load much heavier than it was originally designed for.

The main car house 72 × 156 ft. adjoins the power station, is of brick and one story in height.

The officers of the company are J. N. Beckley, president; A. E. Butler, treasurer; N. E. Morton, superintendent.

Boston.

A visit to the offices and power stations of the West End Street Railway is always an extremely pleasant feature of a trip to Boston, and being in that city recently, we lost no time in calling at the large power station on Harrison and Albany Avenues. The work of construction and installation of apparatus here is being pushed forward as rapidly as possible. The engine equipment, as stated in a former issue, will consist of thirteen units of 2,000 H. P. each, and six of these are already in place They are triple expansion, condensing, Reynolds-Corliss engines, built by E. P. Allis & Co. of Milwaukee, Wis. Only one of the 500 K. W. Thomson-Houston M. P. generators which have been adopted as a unit, has been installed yet, but a very good idea of the future interior appearance of the station can be obtained. The switchboard will be in a separate room adjoining the engine room, and the amount of copper required to connect the generators with the board will be 28,000 ft. of 600,000 circular mils section. The company are also building a station at Cambridge, which will have a capacity of 5,000 H. P., and will use three engines of the type employed at the main station. These engines are already in position.

The current for the cars at present in use is supplied from the Allston station, and from the temporary plant at the main station, part of the generators being at present located in the future boiler room and part in a frame structure.

A visit to the manufacturing and repair shops of the West End company in the large brick building, formerly the Hinkley Locomotive Works, and adjoining the power station, showed a scene of great activity. The lower floor is devoted to the inspection and repair of the running gear. Here was also a new truck which the West End company are building for their long cars. It is of the the radial pattern which has proved successful on West End Railway, but with eight wheels. There are two wheels of the usual size at each end which carry the motors, and a small four wheel truck in the centre. There have been many reports that the West End company contemplate abandoning the use of long cars. This, we were officially informed, is not true.

The system for a "return" adopted by the West End company is most complete, and as it has not been mentioned in these pages, a few words of description here will undoubtedly prove of interest. In the first place, the ends of adjoining rails are bonded, whether they are also joined by angle plates or not, and every track has at least one supplementary copper wire to which every bond is connected. In some cases as many as five supplementary copper wires are carried between the rails. To still further reduce the resistance of this side of the circuit, heavy copper plates are sunk in the bay near the station and connected to the earth terminal on the switchboard, similar plates being sunk in the Charles River and at other points on the line where opportunity affords and connected with the rails. Not being satisfied with even this, the company use a number of direct overhead connections between the rails on distant portions of the line and the switchboard. Copper is the material employed for the bonds, and the total amount of this metal purchased by the West End company during the last three months of 1891, in the shape of feed wire, trolley wire, bonds, etc., aggregated a million and a quarter pounds.

The present practice at the station is to connect the positive pole of the generator to the earth, and the negative to line, the theory being that this not only reduces the electrolytic action on the copper bonds, but also helps the action of the lightning arresters by providing a flow of current, toward the station instead of away from it. Lightning arresters are used on each car, on each feeder at the switchboard, and a lightning arrester and choking coil is between each generator and the earth.

The problem of fenders has troubled the company to a considerable extent. As mentioned in a previous issue, a committee consisting of Prof. Geo. F. Swaine of the Massachusetts Institute of Technology, W. B. Clark of the West End company and C. E. A. Barrett, treasurer of the Boston & Lowell Railroad Co., were requested by President Whitney to determine the best type of fender and safeguard to use on the Boston electric cars. An elaborate series of experiments has been tried by this committee, and the number of different devices tested was about fifty. The fender trials were made both with long and short cars, and consisted in picking up straw dummies placed on the track. As a result, the company have practically decided upon the adoption of a fender for their long cars, the type of fender best suitable for the short cars not having yet been determined. The long car fender consists of a rectangular wire netting projecting, when in use, about four feet in front of the car and carried horizontally about four inches above the track. The netting is upon a frame, three sides of which are of iron, the fourth side, the front, being made of stout rubber. The device is always in position when the car is in operation, the committee having early decided that the use of an adjustable fender dependent for action in case of danger upon the presence of mind of the motorman was objectionable. Forty cars will be equipped with this device immediately, and if it proves satisfactory all the long cars will be provided with it.

According to the present system of appointments every new motorman on the road has to serve first as a motor inspector or helper in the repair shop from two to six weeks, or until he shows his familiarity with the motive apparatus. He is then given a certificate of competency signed by the superintendent of electric power, which can be revoked for cause. This system is being extended to all the motormen in the employ of the company as rapidly as possible and will go far toward insuring the best of care of the motors on the part of the operators.

DUANE DOTY in a recent article published in the *Herald*, of Chicago, reviews at length the annual report of the patent commissioner.

This reference to electrical invention is made: "What could better illustrate the marvelous advance in electrical industry than the fact that 1,250 patents, or four a day, were issued upon devices where electricity is used; of these we find 32 upon electric lighting systems, 7 on electric heaters, 49 relating to dynamos, 25 of them being for electrical machine dynamo, 30 on electric meters, 66 on electric motors, 39 on electric switches and 34 on electrodes.

"Hundreds of millions of dollars are now invested in the many applications of electricity, and a new profession—electrical engineering—has been created and the subject is taught in all our colleges and universities; all of this is the growth of little more than ten years. The above electrical patents do not include those relating to the telegraph and telephone." The railway patent list is thus alluded to: "Under the heading 'railway' the record shows 739 patents for the year, or two a day; of these 9 are for time signals, 10 for metallic ties, 40 for railway ties, 10 for spikes, 55 for switches, 42 on rails, 15 on railway gates, 10 on frogs, 8 on elevated railroads and 94 on electric railways."

Liverpool's Street Railways.

By J. McGhie.

Although the street railway with its polished rails and easy running cars, has not pervaded England to the extent it has in this country, yet some of its cities possess systems which can vie with our best ones in general excellence and interest. London, Birmingham, Glasgow and some of the Yorkshire and other northern towns are equipped with rolling stock which is a credit to them and an example to other cities. London has several systems, its size being such that no one company has been found equal to purveying universally to the transit requirements of that mammoth aggregation of human beings. Wise in their generation, however, the tramway companies keep strictly to their own territories, and competition outside of the omnibus companies, is unknown.

Liverpool, that city of 650,000 souls which the average American only catches a passing glimpse of as he hurries from the landing stage to the railroad station, stands unique in the possession of an almost perfect street horse railway system.

Its position on the banks of the Mersey, with its business quarters spread in a small area along the docks, and its residential portion distributed in a huge semi-circle around this, has rendered the general disposition of its car lines peculiarly simple. All of these lines, with the exception of those which cross the radial ones on the further side of the semi-circle, converge to the great landing stage—a huge floating wharf three quarters of a mile long—whence all the Mersey ferries run, and in the map appear as radii of the semi-circle just mentioned. Here the aggregation of car lines has the general appearance of an approach to the terminus of some great railroad. Each car, as it reaches the landing stage, runs on its own line along the water front, or what is known as the Pier Head, for a short distance, comes to rest for a few minutes, and then starts on its return journey.

The entire system of tramways is in the hands of one company—the Liverpool United Tramways & Omnibus Co., which is also proprietor of all the omnibuses with the exception of fifteen—seven of which run in opposition to it while eight work in co-operation with it. The origin of this company goes back as far as 1860, when a few omnibuses plied about Liverpool in opposition to each other. The owners of these, obeying the consolidating impulse of the day, amalgamated their interests and formed the Liverpool Road & Omnibus Co. They might have continued to run omnibuses until this day, had not some American gentlemen in 1868, fully alive to the advantages of running cars on rails, gone over to Liverpool and there formed a company to lay down car lines and run cars. This Liverpool Road & Railway Co. laid down six or seven miles of rails, but the public, refusing to recognize its efforts to secure its patronage, the cars were run without profit until 1876, when omnibus and car company joined hands and became the corporation which operates the lines at present. The new company began to extend its operations without loss of time, and has worked to such effect that to-day there are between sixty to seventy miles of double car track. Sixty-one and a half of these are worked at present; the remainder, lying on the outskirts, are not used, as their operation would be unprofitable.

This company, also, runs a line of omnibuses along the ten miles of granite docks. These omnibuses are of peculiarly heavy construction, with slightly flanged wheels, and are run on the ordinary tracks of the steam railroad which is used to remove the cargoes of vessels unloading at the wharves. The overhead dock railroad, which one of the shareholders terms a 'monster on crutches,' of which a full description was given in the February number, will do away with these, owing to the withdrawal by the Mersey Docks & Harbor Board of the right to run them over the dock lines, but new omnibuses are now being built to run outside the dock gates, and the toll now paid to the Dock Board will then be so much money saved.

By a clause in the company's franchise, the corporation of Liverpool and other local authorities possessed the right to take over all the lines of the company at the termination of the lease. This lease terminated in 1880, and the corporation decided to take advantage of its right. The lines were taken over and are now rented to the car company. Up to the year 1880, the company had constructed all car lines, but the corporation now does this work, and has also the charge of maintaining the road in good order. The corporation receives from the company 10 per cent. on the cost of construction, which is £6,000 ($24,800) per mile, while the other local authorities receive 9 per cent. on the same amount.

The grooved rail is exclusively used. These rails are securely bolted to heavy wooden stringers, impregnated with creosote which are laid on ties. Tie rods are also used. The bed of the road is solid concrete, laid on a foundation of well tamped rubble. Over the concrete is run a heavy layer of pitch covered with a light bed of sand in which the granite blocks are laid. The interstices between the stones are grouted with fine screened pebbles and filled with pitch, and the result is a roadbed which almost defies wear and time.

The tram cars are large four wheeled, single truck vehicles with places for passengers inside and on the top, and are capable of carrying, when all places are filled, about fifty passengers. Each car is drawn by three horses, two in the heavy harness and one tandem. Their carrying capacity is limited to the number of places provided, and the standing passenger uneasily hanging to a pendent strap is unknown. A by-law of the municipality, stringently enforced, is an especial safeguard against any overloading of the cars, and as soon as the interior or exterior places are completely filled, the conductor puts up a sign to that effect, and warns off those who, on this side, would crowd in or hang on to the rail and steps. The driver sits on a level with the passengers of the inside, the roof of the car projecting as a shelter over him, as on our cars. As no one is allowed to stand on the platform, the vacant space beside the driver is utilized for such bundles and packages as are too bulky to be carried inside or on top with the passengers.

In order to facilitate the running of cars at the intersection of Byron, Manchester and Victoria Streets, St. John's Lane and Whitechapel, where there is a constant flux of heavy traffic, a regular switchman's box has been constructed. Semaphores are erected at a short distance before the switch is reached and, as on the steam railroads, are worked by levers, also controlling the switches, operated by the switchman from the box. This is, we believe, the only instance in which the railroad switch system has been applied to the horse car system, and it works admirably.

The cars are built by the company at an average cost per car of $900 (£200), and are roomy, fine looking, well upholstered with cushions, easy running and comfortable. The average earning per car is about $106 (£22) per week, allowance being made for restricted service on Sunday when the ordinary Liverpudlian has little or no use for street railway cars.

The total number of cars constructed to date is 234, of which 171 are in constant use. They run in the aggregate about 4,000,000 miles per year, and carry on an average about 28,000,000 passengers. The total number of omnibuses at present built is 133, of which eighty-seven are in use. These travel about 1,700,000 miles, and carry about 8,000,000 passengers annually. The total mileage covered by the conveyances of the company is, therefore, about 5,700,000, and the total number of passengers 36,000,000. This for a city with a population of about 650,000 (Bootle being counted in as it is partially covered by the same system) is, perhaps, not very considerable, but it must be remembered that the average Englishman walks in many cases when his American brother would avail himself of the cars.

The number of employes is 1,450, and the company now has in its stables a stud of 3,162 horses. Each horse travels fourteen miles a day, and lasts about six or seven years. They are heavy, powerful beasts of Flemish or Norman breed, and usually end their days on some farm.

They consume a daily average of thirty-one pounds of provender—hay, beans and Indian corn—per day. This is about three pounds more than do the horses of car companies in other towns of England, but they have to cope with the hard work of pulling the cars up some very steep gradients, a sudden rise, beginning about a mile and a half from the river, almost mathematically dividing the business portion of the city from the residential quarter. It can easily be realized that a daily increase of 9,500 lbs of feed amounts to a very perceptible addition in the cost of maintenance of the stud at the end of the year. The average price paid per horse is about $155 (£32).

The fares are so arranged as to run from a minimum of one penny (two cents) to a maximum of six pence (twelve cents) according to distance. To check these fares the bell punch, an American invention, is used. Even using this and compelling the conductor to punch the ticket before the passenger, was not found a sufficient safeguard against the "knocking down" of fares, but the ingenuity of Mr. O'Neill, the manager of the line, has almost reduced the chances of dishonesty to a minimum. Formerly, the conductor punched a hole in the ticket, the color of which denoted the amount of fare paid, before handing it to the passenger ; now, he is obliged to punch one hole for each penny paid. In the former case, the pieces punched out of the tickets fell into a receptacle, and were counted as a check on the conductor. This was a tedious task and materially increased the cost of labor. An improvement on the registering punch was made, and now each time a ticket is punched the machine registers, and the conductor turns in his correct number of pennies at the end of his trip. The passengers are expected, as here, to act as an additional check on the conductor. Each car conductor carries in a small oblong frame attached to his leather cash satchel, a sheet with numbers printed upon it. The inspectors or "spotters" board the car unexpectedly at different points, and cancel the number corresponding with that of the passengers which the car is at that moment carrying. With all these precautions taken to keep the conductor straight, he generally finds that honesty is the better policy.

To the American, notwithstanding his practical spirit and general keenness after profit, the plastering of advertisements over the horse cars seems anomalous and unsightly, but in Liverpool, the cars are used extensively as advertising media, and both the exteriors and interiors are utilized.

The city seems to be no nearer the adoption of a system of mechanical haulage that will successfully supersede the horse, than it was before the latest developments in rapid transit were introduced here, although the company expresses itself as anxious to adopt some scheme in that direction if it can at a price, if not cheaper than, then at least as cheap as, horses. All kinds of haulage systems have been offered to it, and extensive experiments made. Compressed air was tried by the promoters under favorable circumstances, but was found by them unprofitable. The cable system was offered, but objected to by the corporation, who, unlike that of New York, view the tearing up of their streets with horror, and, as tenants, the company had to abide by the decision of the municipal authorities.

Electricity has also been tried. It was found to answer excellently as a haulage power, but commercially its cost was considerably greater than that of horse traction. An offer of electrical haulage, at seven pence (fourteen cents) per mile, was made to them with an additional charge of $7,700 (£1,600) for each car fully equipped with its electrical machinery. The seven pence per mile was much greater, relatively, than the cost of horse haulage, exclusive of the outlay of £1,600 on each car —which would amount in the aggregate to $1,800,000 (£374,400). The company seems to have been unlucky in its electrical experiments, for the same electrical concern which offered to haul its cars for fourteen cents a mile offered, subsequently, to the Glasgow municipality, to haul its cars for seven cents a mile, laying the difference to the fact that Liverpool is a city of steep gradients. The tramway company is now anxiously studying the results of the Thomson-Houston installation at Roundhay, Leeds, with a view of adopting electrical power as soon as it can be shown that under the different conditions an American system can be operated in England at a commercial profit over horses.

The Tramway company has had, like most companies formed for a similar purpose, to make a struggle for its existence, but it has now reached a period of comparative prosperity. Its mortgage debt in 1884 amounted to 417,600 (£86,980); it has been reduced to $91,200 (£19,000). In 1883 it was shackled with a good-will account of $1,173,600 (£244,500) which has been so reduced that now it amounts to no more than $363,600 (£75,750). The shareholders are receiving a regular dividend of 5 per cent. per annum, and the company is so operating the cars to the satisfaction of the public that there is no doubt that its franchise will be extended at the close of the lease now running. The improvement in the general status of the company, and the perfection to which the system has been brought are due almost entirely to the energetic devotion and perseverance of Mr. J. O'Neill, the manager and secretary, who has now been twenty-six years with it, and has, so to speak, fostered it from its youth up.

Asphalt: Where and How Mined.

Since asphalt is being extensively used as a paving material, it is interesting to know something of its origin and where it is found and how prepared for use. The Department of Public Works, of New York City, having had certain pavements constructed with an inferior asphalt, undertook an investigation and made tests of the material as supplied by different contractors ; and in order to make a careful study of the subject the commissioner, Mr. Thomas F. Gilroy, directed that the consulting engineer, Mr. Stevenson Towle, visit the asphalt lake on the Island of Trinidad and personally examine the deposits and method of mining. In obedience to these instructions

FIG. 1.—ASPHALT LAKE—SOFT ASPHALT IN CENTER.

Mr. Towle visited Trinidad in October, 1891, and in a report recently presented to the Department of Public Works, he has given a very interesting account of this visit, from which, by permission we make the following extracts, and have produced the accompanying illustrations from photographs kindly furnished by him :

Asphalt is found in different parts of Trinidad, but only in the district of La Brea (Spanish for "The Pitch") is it found in sufficient quantity for commerce, or of a quality suitable for street pavements. The wonderful Pitch Lake is situated there, and also with the extensive deposits of "iron pitch" and "land pitch" on the slope between the lake and Gulf of Paria.

The lake is about one mile from the sea, at an eleva-

tion of 138 ft. and contains 115 acres. It is quite circular in shape, and the outlines are well defined. On the south the land rises gradually from the lake, to the sea.

The surface of the lake is not level. It has an inclination of a few inches in one direction, sufficient to drain off the frequent rainfalls. Besides this slight inclination, the surface has a fall of a few inches from the centre toward all sides. Another and distinct characteristic is that the surface is not flat and even, but is formed of irregular, oval-shaped, flattened domes, or slightly convex

FIG. 2.—DIGGING AND LOADING ASPHALT.

surfaces, separated by channels of water a few feet wide and a few inches deep, flowing toward outlets. There are several small islands, from fifty to sixty feet in diameter, scattered over the surface of the lake, and resting on the asphalt itself. These islands have sufficient depth of soil to support the growth of quite large trees. The whole appearance of the lake is very odd, strange and difficult to describe. In color it is a dark chocolate brown, and looks very like a patch of mushrooms flattened out and pressed closely together, separated only by the narrow and shallow channels of water already described. In the centre of the lake is a space of several hundred square feet of soft, fluid asphalt. This is the celebrated "Pitch" or "Boiling Spring" (Fig. 1). Here the temperature is colder than in the solid parts of the lake. The appearance of boiling is due to the escape of large volumes of sulphureted hydrogen gas, which keeps the liquid mass violently agitated. This "spring" is commonly, but erroneously, thought to be the source of supply. In fact, it is the last of the asphaltic deposits, and is ages more recent than the deposits of "iron" and "land pitch," and much more recent than the solid part of the lake itself. This very fact should prove conclusively that the lake has never overflowed to form the deposits outside it, and that these deposits of "iron" and "land pitch" had no such origin.

The surface of the lake is sufficiently firm to support the weight of the loaded carts. The asphalt is mined for commerce from different parts of the lake to a convenient depth of about three feet. It is easily excavated with picks, loaded directly into carts (Fig. 2), and hauled to the shore ready for shipment (Fig. 3). A marked peculiarity of the Pitch Lake is, that the pits or excavations made during the day fill up during the night, and in a few days no trace of them can be found. This is due to the great viscosity of the lake asphalt, and is one of the features which distinguish it from all other asphalts found in this district. On the slopes from the lakes to the sea, and beneath the sea itself, are found the vast deposits known as "iron" and "land pitch." The greater part of these are covered with several feet of earth, supporting a dense tropical forest growth. The village of La Brea is over these deposits, the houses and streets resting directly on the pitch itself. These deposits are known by American dealers as "overflow pitch," but the inhabitants and geologists term them "iron" and "land pitch." The asphalt from these deposits varies in color from gray to black (Fig. 4). The "iron pitch" exists in extensive compact masses of detached deposits, and is extremely hard and brittle, and almost black in color. The "land pitch" is found mixed with more or less dirt and foreign matter, and varies in color from gray to black. Both kinds are mined from the village lots and from deposits on both sides of the road leading from the village to the lake. These village plots are the ordinary size village lots, and are generally occupied by the cabins of the owners, who either mine the deposits themselves or lease them to others for mining. The asphalt is carted to the shore and piled in heaps ready for shipment, which is almost exclusively to the United States. The cargoes are often made up of asphalt mined from several different deposits. This accounts for the great variety met with in the same shipment. I noticed one pile made up in this way, and adjoining it a pile of "lake" asphalt. The difference in the two was very marked. The pile of "land" and, "iron pitch" was of a variety of colors, from gray or black, lustreless and brittle, and mixed with earth and decomposed asphalt. This latter feature was owing, no doubt, to careless sorting and "cutlassing," as the cutting and trimming off the decomposed surfaces of the deposit is called. The pile of asphalt from the lake was bright and uniform in color. Another peculiarity of the "iron" and "land pitch" is that when excavations are made the walls of the remaining asphalt do not run in and fill up the excavation. The angles and projections only are rounded off and softened by the sun's heat. This shows that these kinds flow but slowly, if at all, and in this respect are very different from the lake deposit.

The different asphalts found on the island of Trinidad have, undoubtedly, a common origin. Geologists, however, differ on this point. Messrs. Wall and Sawkins, government geologists, hold that the asphalts are of vegetable origin, and formed in the same way as peat and coal. In this opinion most geologists agree. Others claim that the asphalts are of volcanic orgin, and some hold that the source is to be found on the mainland of

FIG. 3.—LOADING ASPHALT UPON LIGHTERS.

South America opposite, where there are found vast deposits.

* * * *

I collected and brought home with me samples of asphalt from different mines in the La Brea district, which are fair samples of the different deposits. These I submitted for analyses, and from the report of the analyses it was found there is a difference of 3·80 per cent. in the bitumen contained in the respective samples. A marked difference in the softening points will also be observed, the variation being as great as ninety degrees Fah. In asphaltic oil there is a difference of 3.68 per cent. These differences

are in favor of the lake asphalt, which contains a much larger quantity of bitumen and asphaltic oil than the samples of the other deposits, and will require the addition of less residuum oil in the preparation of the asphaltic cement for street pavements.

In my judgment, asphalt showing a deficiency of asphaltic oil is not suitable for pavements, as deficiency in that oil detracts from the durability of the asphalt.

The analyses also show that the asphalts containing the least asphaltic oil have the highest softening point, and are consequently harder and more brittle than asphalts with a lower softening point, and correspondingly greater elasticity, which latter quality paving experts consider essential, as it gives the pavement the necessary adhesiveness.

Trinidad asphalt is extensively used in Europe in the pavement of sidewalks, and a condition in the specifications for such work is that the asphalt shall be "viscous and not brittle under ordinary temperatures."

This large proportion of lake asphalt exported to Europe would indicate that the lake asphalt alone meets the requirements of foreign specifications.

Statistics show that 41,177 tons of raw and 4,827 tons of refined asphalt, taken from lands outside the lake,

FIG. 4.—LAND PITCH—LA BREA VILLAGE.

were imported into the United States, the greater part having been used in pavements.

The lake asphalt is mined and exported exclusively by the Trinidad Asphalt Co., and is imported into the United States by the Barber Asphalt Paving Co., the Warren-Scharf Asphalt Paving Co., and the Crawford Paving Co.

The durability of asphalt pavements depends wholly on the suitability of the asphalt for the purpose. It must be of such a nature as to permanently and thoroughly cement together the sand and limestone powder forming the body of the pavement. It must be elastic, independent of the residuum oil required in making the paving cement, and in no degree brittle.

To secure materials that may be relied on to make the best pavements, it is the practice of European engineers to designate in the specificatons not only the kind of asphalt to be used, but also to name the mines and companies that will be allowed to furnish the material, and only to receive bids from such contractors as have shown ability to furnish the material required, and have done satisfactory work.

It has been found necessary to follow this practice in this city as to material for rock asphalt pavements, and the same course should be followed with regard to the Trinidad asphalt pavements.

In view of the importance of obtaining the best asphalt, I would recommend that the asphalt from the Pitch Lake at La Brea, Trinidad, be made the standard of quality. This standard is now required by the specifications for asphalt pavements in Washington."

Meeting of the Tramways Institute of Great Britain and Ireland.

The first quarterly journal, for 1892, published by the Tramways Institute of Great Britain and Ireland, has recently been issued and contains the reports of the tenth quarterly meeting of the Institute held at Alexandra Hotel, Bradford, January 7-8. The president, Mr. W. J. Carruthers-Wain occupied the chair. The papers read were on the "Bradford Corporation Tramways," by J. H. Cox, an abstract of which we give below, on "Steam Traction," by W. Vaux and on "Gas as a Locomotive Power in Connection with Street Tramways" by Nott Knight.

In the report of the Rating Committee, which was the business first brought before the Association, and during the discussion which followed the report, it was shown that the street railway tracks were very heavily assessed, in some instances as high as £400 per mile, and that one company, the Swansea Tramway Co., was now engaged in litigation in the hope of securing an allowance of 75 per cent. on the net ratable value. A resolution was passed contributing the sum of 100 guineas towards the costs of this company in their suit, on the understanding that the Attorney-General be retained by them to argue the case. Below is an abstract of the paper by J. H. Cox, City Surveyor of Bradford, entitled :

THE BRADFORD CORPORATION TRAMWAYS.

The town of Bradford, which owns its tramways, leasing them to an operating company, is somewhat peculiarly situated in the bend of a deep valley. The population at the end of the census of last year was 216,361. The area of the borough is 10,776 acres. The corporation for the last quarter of a century, in addition to carrying out the ordinary duties of a sanitary authority, have shown great public spirit in establishing or acquiring pretty nearly all the large undertakings which are necessary for the prosperity of a large manufacturing town, and at the present time they are the owners of the waterworks, gasworks, electric lighting works, markets (both wholesale and retail), public abattoirs, cemeteries, parks, public baths, museum and free libraries, fever and small pox hospitals, convalescent home, and eighteen and a half miles of tramways.

The generally steep and narrow character of the main roads converging to the town was instrumental in delaying the introduction of tramways, but the necessity of better means of locomotion was severely felt even twenty years ago, when, with the exception of the Great Northern Railway to Laisterdyke, and a few small omnibuses which ran at long and irregular intervals, no facilities for quick traveling existed whatever. A corporation which had ministered so well for the requirements of the inhabitants in other matters was scarcely likely to allow the construction of tramways within the borough to fall into the hands of outside promoters, and so it happened that in the year 1880 the Town Council applied for and obtained powers to construct tramways on three routes, viz., Manningham Lane, Leeds Road and Sunbridge Road, having a total length equal to seven and a half miles of single line.

Previous to commencing the construction of the lines, tenders were invited for leasing and working them when complete, and ultimately they were leased to Messrs. Turton, Mason and Busby, of Leeds and Liverpool, for twenty-one years at an annual rental of £290 per mile for the first ten years, and £300 a year for the remainder of the term—equal to about 7¼ per cent. on the outlay.

The rail used is of the Winby & Levick type and is of steel six inches high, with a bottom flange three and a half inches wide, weighs sixty-five pounds to the yard, and is rolled in lengths of twenty-four feet. The rails are mounted on wrought iron base plates each twelve feet long, twelve inches wide, and three-eighths of an inch thick, and are secured thereto by means of cotter bolts and cotters at intervals of two feet on alternate sides of the rail. The Manningham Lane section was opened on January 31, 1882, and for the first seven years was worked exclusively by horse power, during which time the repairs were nil. Since October, 1888, steam power has been used in addition to horses, and from that time the cost of maintaining the line has rapidly increased. The Leeds Road section was opened in June, 1882, and the Sunbridge Road line followed in September of the same year. Both these lines have been worked entirely by steam power from the first. The gauge is four feet. The rails were provided and laid at £1,998 per mile, and the concrete foundation and granite paving were laid by the corporation workmen at a cost of £2,500 per mile.

In 1882 a six and a half mile extension was laid, the type of rail used being of Bessemer steel of the girder pattern, seven inches deep and seven and a half inches bottom flange, weighing 103 lbs. to the yard, at the price of £8 10s. per ton, delivered at Bradford. Contracts were subsequently made for the supply of similar rails at the reduced rates of £7 18s. 9d. per ton and £7 16s. 3d. per ton respectively.

The girder rails were rolled in thirty foot lengths, and cost, including laying, but exclusive of points and crossings, £1,750 per mile. The foundation for the roadway was laid on a bed of concrete six inches in thickness, composed of broken stone and lias lime in the proportion of six to one. The surface of the concrete for the width of the tramway was floated to a smooth face and the rails laid thereon, but as it was found impossible to make the bottom flange of the rail to touch the concrete at all points, it was decided to run a thin layer of hot pitch underneath to fill the intervening space. At this time the rails were fished with steel fish plates only sixteen inches long and weighing twenty-two pounds per pair, bolted together with bolts one inch in diameter and nuts to match, each bolt and nut together weighing one pound five ounces.

Tramway engineers and managers have found out by stern experience that the rail jointing or fishing is the weakest part of the line, especially where steam traction is adopted ; and in two or three of the

later tramway extensions in Bradford the fish plates have been lengthened, first to two feet, then to two feet six inches, and now it has been decided to have the next lot made three feet in length. The section of the fish plates will likewise undergo alterations, and eight bolts will be provided instead of four. Shoe plates of wrought iron, half an inch thick and twelve inches square, have been placed under the ends of the rails to prevent one rail sinking below another at the joints, but in future these shoe plates will be increased in length to at least two feet. Marshall's patent spring points have been largely used on the Bradford tramways, and they have been found very suitable and reliable for steam traffic. A marked improvement has also been made by the insertion of Dawson's patent drain rails for intercepting water flowing down the grooves of the train rails and conveying it direct into the sewer, thus preventing damage to loose joints and avoiding pools of water in various places on the track. The sides of the rails were plastered flush with the top flanges with a mixture of Portland cement and river sand, in order that no hollow space should be left between the rail and the paving setts abutting thereon.

The whole of the carriage way, including the width of the tramway, was paved with granite setts three inches by six inches. The joints of the paving were grouted with a mixture of hot tar and pitch. The Manchester Road line was completed and opened on September 5, 1884, after being leased to the Bradford & Shelf Tramway Co. for a term of twenty-one years, at a yearly rental of £400 per mile of single line, equal to about 11 per cent. on the outlay. The total amount expended on the construction of tramways in Bradford to this date is £76,500, and the term for repayment of the borrowed money is thirty years. The tramways are maintained by the corporation, and during the last two or three years the cost of maintenance has become a somewhat serious question, and this is attributable to several causes. In the first place, the original lines laid on Winby & Levick's system are not sufficiently substantial for the ponderous engines and cars which are now used ; in the second place, large quantities of water are discharged on to the tracks in all weathers, and a large proportion of this water finds its way into the loose joints of the rails, where it occasionally becomes frozen. At other times a sort of churning process goes on at these loose joints, which in many cases softens the underlying concrete. No doubt great wear and tear is caused by the incessant application of the brakes on the downward journey, rendered necessary by the long and severe gradients which exist on nearly all the Bradford tramways. In order to secure the adhesion necessary to climb these steep inclinations, amounting in several cases to one in fifteen, heavier and more powerful engines have been introduced, dragging huge bogie cars capable of carrying sixty persons, until the old practice of using sixteen inch fish plates has proved quite inadequate to meet the strain. The actual wear of the tread of the rail on the Leeds Road single line is five-sixteenths of an inch in nine and a half years, and a quarter of an inch at the passing places. On the Manchester Road tramway the wear on the up and down lines is practically the same, viz.: five-sixteenths of an inch in seven years.

When the tramways were first commenced in Bradford, an arrangement was entered into whereby the Street and Drainage Committee undertook to keep in repair the paving between the tram rails and for a space of eighteen inches beyond, in consideration of receiving an annual payment from the Tramways Committee equal to £35 per mile of single line. Of course for the first few years the repairs were practically *nil*, but during the last few years the cost of keeping the paving in order has exceeded the amount allowed to such an extent that, long before one-half of the term of the lease is expired, the Street and Drainage Committee will be out of pocket unless a fresh arrangement is made. It may be urged that it all comes out of one pocket, and that even if tramways were not laid along these streets the space in the centre would have to be paved for ordinary traffic. No doubt there is something in this argument, but not so much as would appear at first sight, because the four or eight continuous straight joints caused in the paving by the single or double set of tram rails respectively are a source of very great weakness to the road.

The average cost of maintaining the eight and a third miles of tramway on Winby & Levick's system, for the first eight and a half years, has been £53 per mile per annum of single line. If steam had been used on the Manningham Lane section from the opening of the line, the cost of maintenance would have been about £75 per mile instead of £53. The average cost of maintaining the Manchester Road line for the first six and a quarter years, on the girder rail system, has been £28 per mile of single track per annum. Of course, the expense of maintenance is increasing rapidly every year, and it is very probable that some of the lines will have to be renewed before the expiration of the lease, eleven years hence.

In 1890 the Bradford corporation obtained a provisional order for constructing tramways in Wakefield Road and Bolton Road, but before laying them they considered it advisable—having regard to the great expense of maintaining the lines for steam traction—to ascertain if any other motive power could be adopted which would be suitable for working the steep and tortuous route.

The cable system of traction was well considered, and I presented to the Corporation Tramways Committee a report on the subject in October, 1890, pointing out at length the merits and demerits of the system.

There is no need to repeat to an audience like this the many advantages which may reasonably be urged in favor of the cable system when applied to tram routes with severe gradients in populous districts which are able to support a very rapid service of cars ; but it was felt by the Tramways committee that the Wakefield Road and Dudley Hill route, although running through an improved district, could not at present provide traffic to warrant a quicker service than about fifteen minutes.

Further consideration of cable haulage was, therefore, dropped for the time, and inquiries were made respecting the capabilities of electricity as a motive power.

In order to obtain some notion as to the capabilities of electricity in propelling tram cars on steep gradients, the Tramways Committee have entered into an arrangement with Mr. M. Holroyd Smith, acting with Messrs. Easton and Anderson, whereby those gentlemen are to fix, by means of poles and span wires, an overhead conductor, consisting of a slotted copper tube three-quarters of an inch in diameter, placed midway between the two existing tramway tracks, a total distance of 624 yds. ; starting with a totally level gradient of 1 in 340 for 50 yds., then curving into Cheapside on a gradient of 1 in 13.22, with a radius of 64 ft. 6 ins., followed by a straight inclination of 1 in 14.75 for 193 yds., 1 in 20 for 137 yds., and terminating at the end of a tolerably level gradient of 1 in 104 for 150 yds.

A car is being specially built for the purpose, will be fitted with two fifteen H. P. motors, and will be capable of carrying thirty-six passengers—eighteen inside and eighteen outside.

The corporation undertake to supply the electric current required during the experiment from the Electric Lighting Works, in Bolton Road, at a pressure of 300 volts. It is intended to run the car for about one month during the hours of daylight so as not to interfere with the electric lighting of the town.

A record will be kept of the energy expended in climbing each of the inclinations referred to, together with the rates of speed, distances traveled, and number of passengers carried during each journey ; and special attention will be paid to the amount of energy required to start the car on the respective gradients.

It is hoped that the information will enable the committee to form some approximate idea as to the capabilities of electricity as a motive power for working tramways, and guide them in coming to some decision with respect to their future tramway extensions, and more especially as regards Wakefield Road. If the results of the experiment are sufficiently encouraging, it is intended to supply the electricity for working the Wakefield Road line from existing works.

The Electric Street Railway and the City.

"The Electric Street Railway in its Relation to City Life" was the subject of discussion at a meeting of the Providence (R. I.) Commercial Club, held at the Narragansett Hotel, May 14. The speakers were T. Commerford Martin of New York, editor of the *Electrical Engineer;* Prof. Elihu Thomson of Lynn, of the Thomson-Houston Electric Co.; Henry M. Whitney, Esq., of Boston, president of the West End Street Railway Co., and Lieut. O. T. Crosby of Lynn, of the Thomson-Houston Co. Capt. Eugene Griffin of Boston, who was to have been one of the speakers, was unable to be present.

Among others present were C. A. Coffin, H. M. Daggett, Jr., Ex-Gov. Littlefield and G. C. Sims. After dinner had been served and enjoyed President Watson introduced as the first speaker Mr. T. Commerford Martin, who spoke in part as follows :

Five years ago the electric railway was practically an unknown thing in America. The suddenness and brilliancy of its development have been equaled only by the abuse and calumny that have marked its advance. Like every new thing, it has its shortcomings ; like every great invention, it has still to pass through many stages of improvement ; like many an innovation, it offends some tender sensibility or deeply rooted prejudice; and the old battle that has been fought so often has to be fought again.

At the close of last year there were in this country 10,599 miles of street railway with 35,877 cars. Of these, 4,061 miles were electric and 8,892 cars were electric. The total of horse, cable and electric mileage had increased during the year 1,490 miles, but electricity standing alone had increased 1,538 miles. The total of horse, cable and electric cars had increased during the year 3,826 cars, but electricity standing alone had increased 3,300 cars. There were at the end of the year seven times as many miles of electric road as of cable, and more than twice as many electric cars as there were cable cars. There were at the end of the year over 400 electric roads in America. Last March, in looking over the figures of population, I ascertained that of the sixteen cities in the United States having over 200,000 inhabitants, 14, or 87 per cent., were equipped with electric roads. Of the forty-two cities having between 50,000 and 200,000 inhabitants, 41, or 97 ½ per cent., had electric roads. Of the remaining 391 American cities with a population of over 8,000, I do not know of a score that have not electric roads or serious plans for establishing one; while since March every one of the larger cities referred to as the exceptions in the above percentages have fallen into line with a formal approval of this new method of urban travel. The investment to date touches $100,000,000.

As everybody knows, steam motors are completely out of favor for use within city limits. Their glorious record of half a century in long distance travel does not deceive any one dwelling in a city as to the insuperable defects and nuisances of noise, smell, smoke, dust, steam escape, oil drippings, etc., which may more readily be tolerated remotely in the open country. And may not the same be said as to the horse? There are, for example, close upon 15,000 horses engaged in hauling street cars around New York city. It is high time that every one of these was dispensed with, as well for its own sake as for that of the city, whose air it assists in polluting, and whose population it aids in driving into closer quarters somewhere else.

There are to-day only 594 miles of cable road in this country. The reason of this simply is that only a large city can support a cable road, and hence a great many of our most active and progressive communities were condemned to the slow travel of the horse car, because there was no temptation to capital to change the method. It is evident that upon such a heavy capitalization as the cable requires, the earnings must be

very heavy, but there are not a great many cities in the Union that would warrant such an investment.

For the vast majority of our cities and towns, then, electricity becomes the sole means by which they can enjoy that which counts for so much in the sum of comfort and convenience—swift, clean, frequent and profitable transportation. I look upon electric roads as a beneficial agency in the more equal distribution of a happier population around any centre, thus increasing the value of outlying property, while by the stimulation of local trade enhancing the profit earned in the area lying within the region thereafter more legitimately restricted to business occupance. Facilities of rapid transit also make for a pure city government. Old London is herself an instance of this, for so long as her swarms hived within the narrow limits she was municipally as corrupt as any city could well be, but to-day her population, spread over a vast outer area, and with multiplied means of communication, governs itself as I believe no other community in the world can claim to do.

Henry M. Whitney, president of the West End Street Railroad, of Boston, was the next speaker. Among other things he said: I dare say many of you here have been abroad and are somewhat familiar with the social life of the large cities in the Old World. About two years ago I had the occasion to investigate something of the system of transportation in Germany, and indeed throughout the old cities of the world, with a view to finding out exactly what was the relation between the roads and the cities and what effect it had upon the social life of the population. The city of Berlin has often been quoted in our municipal and legislative halls as an example that should be copied by the cities and towns here.

I found in the city of Berlin with its 1,700,000 inhabitants, that there were but half as many dwelling houses as in Boston with its 450,000 inhabitants. I found in Germany that people lived in large tenement houses upon an average of sixty-five people under a single roof in a depraved condition. Almost as many people in Berlin live in cellars under ground as are contained in this whole city of Providence. The wages paid in Berlin are in many cases not exceeding a quarter of what is paid to the laboring people of this country.

Now, the system of transportation in the State of Massachusetts or in the city of Boston is that a man may go the whole distance of the line for a single fare of five cents. What is the effect of this? It is exactly just what you would expect. The poor people of the American city move into the suburbs, and there find healthful homes for their families. Every year this area grows in extent larger and larger and more and more difficult for the transportation company to meet this condition of things.

No person, to my knowledge, has been seriously injured since the system was put in Boston, three years ago. From that day to this, while it is true two or three horses have been killed, to my knowledge no single person has received any injury worth talking about at all. That this is a deadly current is shown to be a mistake. Hardly a week passes that a lineman does not receive a shock, and burns his fingers, perhaps. I know of no serious case. There is no suit against the company alleging injury from this cause. The experience of the people I represent has been one so far of entire approval of the system as a whole. I am not here before this body of men to say I do not think the wires objectionable. I would be glad if they can be dispensed with.

What has been the effect upon property? It has been what you might expect. That is, if you extend the area to which a man may go and come, you extend the value of your property. You give them advantages for it, and you profit by the trade you receive. We started a line over Beacon Street some years ago. I have lived in Brookline from 1866 to the present time. I lived on the corner of Beacon and Pleasant Streets for more than twenty years. During the whole of that time not a single new house was put upon that street. I believe not one in twenty-five years. The land along the line of that Avenue was selling at from three cents at the reservoir to fifty or sixty cents at St. Mary Street, the dividing line between Boston and Brookline. To-day it is assessed on an average thirty-four cents a foot.

The property on that side increased in five years $3,900,000. The increase within 500 ft. of Beacon Street was something more than $1,900,000. That made an increase of nearly $6,000,000. The rate has been $11 on the $1,000. The whole cost of that improvement, besides sewer and water expenditure, which the town must have put in, and under our system would assess back, was $220,000, making an annual burden at 5 per cent. of $11,000.

Now, I believe that that increase in valuation is very largely due to the fact that we have there a system of electric railroad, and I find the same thing is true wherever the electric system goes. Property becomes more valuable and people desire to live upon the line of the electric road. The consequence is that property advances in price.

President Watson then introduced Prof. Elihu Thomson as the next speaker. Mr. Thomson's address was a graphic description of of how electricity is generated, and its application and uses. The question had often been put to him, What is electricity? What is its real nature? All we know is, it is about the simplest of Nature's agents.

He also spoke briefly upon the disadvantages of the storage battery system, and said the trolley system had taken its place. If anything comes up that is better than the trolley the railroad companies will at once conform to it. But let us do the best for the present with the things that are at our disposal. A great deal has been said about the danger of trolley lines, but our records show that no human being has been seriously injured by the current. The trouble is, people unacquainted with the subject are apt to confuse electricity with lightning.

The last speaker was Lieutenant Crosby, who spoke of the electric road in Richmond, Va., and the tribulations experienced before experience had been gained in the use of electric machinery. He took an interesting view also of the social side of the problem.

Legal.

1. GETTING ON STREET CAR IN MOTION—QUESTION OF FACT. Whether a person in getting upon a street car in motion is chargeable with a want of ordinary care, is a question of fact for the jury. It is not negligence *per se* for a person to get on or off a street car drawn by horses while the car is in motion. An instruction that such act is conclusive evidence of contributory negligence as to bar recovery was properly refused.

2. GREATER CARE REQUIRED IN REGARD TO STEAM CARS. A stricter rule than that applicable to horse cars must be held to apply to steam cars. So an act in getting upon a train drawn by steam, which would amount to gross negligence, might be prudent if done on a horse car, when the latter was not in rapid motion.

3. PLACING TELEPHONE, TELEGRAPH AND ELECTRIC POLES NEAR TRACK—NEGLIGENCE OF. When a street railroad places its track so near such poles or other obstructions which it is necessary for its cars to pass, that its passengers in getting on and off, and while upon them are in danger of being injured by contact, it is a fair question for the jury whether the company is or is not guilty of negligence.

4. RIGHT OF STREET CAR TO STOP AT NEAR CROSSING—INSTRUCTION. In an action by a passenger on a horse car against the company, to recover for a personal injury by being propelled against a pole near the track, while getting on the car in motion, the defendant asked the court to instruct that under the ordinance of the city the company had no right to stop its cars except on the further crossing, which was refused. *Held*, proper, it being immaterial whether the defendant had the right to stop its cars at the further crossing or not, there being no claim that the driver refused to stop the car at the place where the plaintiff got on the car.

5. DANGEROUS USE OF STEPPING BOARD—OBSTRUCTIONS. It has been held that it is inexcusable in a railroad company to permit an obstruction to stand so near its track as to render the use of the running board dangerous to life or limb, inasmuch as exceptional cases may arise where it is lawful and proper for even a passenger to use such stepping board.

6. Where a passenger was injured while standing on the running board, seeking a seat, an instruction as a matter of law, that he had no right to be where he was at the time of the accident, therefore defendant was not liable for the injury unless done willfully. *Held*, to have been properly refused, it failing to state any facts upon which he had no right to be where he was at the time of the accident.

7. USE OF STEPPING BOARD — TRESPASSER. If the plaintiff was merely using the steps for the purpose of ascending into the car, he was where he had a right to be, and if he stood upon the steps too long it could not be said that he was a tresspasser, as to relieve the company from any liability than from an willful injury.

8. WAIVER OF RULES OF CARRIER—NEGLIGENCE. Although a person may get upon a horse car in motion, in violation of a rule of the company, yet if it is made to appear from the evidence that such rule has been waived or revoked in his favor, he will, nevertheless, be entitled to his action for his injuries from any want of care on the part of the company. If the conductor sees that the passenger gets aboard while the car is in motion at a moderate speed and makes no objection or warning, a fair question is presented for the jury to find from all the circumstances whether the rule has not been waived.

9. NO FARE PAID—TRESPASSING. It cannot be held that a party is a trespasser after he gets upon a car, even though no fare has been paid or collected of him before he meets with an injury, simply because he has violated a rule of the company. It is not necessary that there be an express contract in order to constitute the relation of carrier and passenger, nor that there should be a consummated contract. A contract may be implied from slight circumstances, and it need not be actually consummated

by the payment of fare on entry into a car of the carrier. The matter depends largely upon the intention of the person at the time he enters the car. Judgment for plaintiff affirmed.

The North Chicago Street Ry. Co. v. *Williams.* Ill. S. C., January 18, 1892.

Note: This important decision covers numerous points of vastly great interest to street railway managers. Here a distinction is made between horse and steam cars as vehicles of a common carrier. Whether electric and cable cars will be classed as horse or steam cars is not passed upon. The cases decided on these subjects are numerous. On the one hand a passenger in attempting to get on or off a moving railroad (steam) train is guilty of such negligence as to preclude a recovery (53 Ill 510). One knowing the location of the tracks, etc., assumes the risk and cannot recover (35 Ohio St. 627). It has been held that one entering upon a car in violation of the rules of the company is not a passenger: 2 Rover on Railroads, 979; Hutchenson on Carriers, Sec. 587; 72 Md. 377; 2 Wood on Railways, 1,035.

A person who intrudes himself on a train cannot recover for an injury unless willfully inflicted (22 Ill. 633; 131 Ill. 61). On the other hand it has been held to be gross negligence to place even a temporary track in such close proximity to a pole. 91 Ill. 298; 53 Mich. 43.

It is not negligence *per se* for a person to get on or off a street car drawn by horses while it is in motion. It depends upon the circumstances of each case and is a question for the jury (42 Minn. 42; 148 Mass. 210; 49 Hun. 610).

It has been repeatedly adjudicated that it is not negligence, as matter of law, for persons to ride upon the platforms of street cars. 8 Allen 234; 36 N. Y. 135 and 67 N. Y. 596.

The contrary is true of steam cars; 51 Ill. 495; 99 Penna. St. 492. It has been held in a number of cases that riding on the steps of a horse car or side steps (running board) of a horse car would not preclude a recovery for injuries caused by collision with another car or other obstacles (36 N. Y. 135; 1 Sweeney 490; 97 Pa. St. 55; 38 Kans. 375; 37 Mo. 537; 50 N. J. L. 435 and 54 N. Y. 230.

Street Railways—Crossing Steam Railroads—Priority of Right of Way—Grade—Injunction—Equity. The complainant street railway company, having by ordinance obtained consent to construct a line upon certain streets, but when it proceeded to construct its line of railway over and across the line of track of the respondent railway company at the intersection of said streets, the latter company by its agents and employes, illegally and forcibly tore up, removed and destroyed a portion of its line of track; hence this action to enjoin and prevent respondent from interfering in any manner with the construction of complainant's line of track across the respondent's road or tracks at the intersection of B. and F. Streets. On motion to continue the preliminary injunction the court

Held, 1. That the Act of June 19, 1871 (P. L. 1360), regulating the crossing of one railroad by another, does not apply to street passenger railways.

2. That the construction of a street passenger railway upon a street, changes only the mode of use of a public highway, and does not impose on the property over which the highway is laid out and opened, an additional burden or servitude; and this is the case whether the railway is operated by horses or electricity.

3. That the street railway company has no greater rights and privileges toward a steam railroad company whose tracks it crosses, than have the owners of private vehicles or omnibuses used for hire; the steam railroad company has always the superior right of passage.

4. That upon a bill in equity to restrain a railroad company from interfering with the laying of the tracks of a street passenger railway over the tracks of the railroad, the defendant has not the right to complain that the plaintiffs have not built a continuous route as required by the Act of May 14, 1889, under which they were incorporated. The proper remedy in such a case is by *quo warranto.*

5. That a street passenger railway company locating its tracks over a railroad will not be required to file a bond conditioned to compensate the railroad company in damages. In such a case the street passenger railway company being required "to stop, look and listen" before crossing the railroad company's tracks, no damage arises from delay of trains.

Du Bois Street Ry. Co. v. *Buffalo, etc., Ry. Co.*, Pa. Com. Pleas. Ct., Sept. 1891.

Collision at Crossing With Street Car—Negligence—In an action against a railroad company to recover damages for the alleged negligent killing of plaintiff's intestate, it appeared that the decedent was a street car driver, and that in coming toward defendant's track he slowed his car to a walk when he was within about twenty-five or thirty feet of the railroad crossing, and that he could have seen the approaching train seventy-five feet down the track when twenty-five feet away from the crossing, or could have seen the train 160 ft. down the track when within sixteen feet of the crossing; that the deceased did not stop his car, but seemed to be looking at his horses, with his hand on the brake; that there was a flagman regularly stationed at the crossing, but that he was in the flag house and gave no warning of danger.

Held, That it was a question for the jury to determine whether the absence of a flagman from his post of duty warranted deceased in presuming that it was safe to cross defendants' track at the same time, and a finding that the driver was not guilty of contributory negligence would not be disturbed. Judgment affirmed.

Richmond v. *Chicago, etc., Ry. Co.* Mech., S. C., 1891.

Note: This was not a unanimous decision. The principle of law that one about to cross a railroad must stop, look and listen, was excused on the ground that defendant's flagman was on duty, but made no effort to warn the driver of danger; that the negligence of the flagman was the negligence of the defendant. This reasoning has met with some adverse criticism.

Street Railways—Crossing—Contributory Negligence. In an action by plaintiff to recover damages for a wagon crushed by the defendant's cars, while his employe endeavored to drive across defendant's track.

Held, that it is gross negligence to drive in front of a moving street car so near as to make a collision inevitable; such conduct defeats an action to recover for self-inflicted damages.

2. *Charge of Court—Rule as to Looking and Listening. Held*, that it is error in a trial judge to leave a jury without any rule of law governing the duty of a driver when approaching a street railway. It may not be necessary to stop before approaching a street railway crossing, but it is necessary to look before driving on the track.

Carson v. *Federal Street & P. V. Pass. Ry. Co.*, Penna. S. C., January 4, 1892.

Negligence of Company—Hasty Starting of Car—Evidence. Where, in an action to recover damages for loss of services and expenses incurred by reason of the injury of plaintiff's infant son, there was evidence that the conductor of defendant's car signaled the driver to start before plaintiff's five year old boy and his attendant had reached a place of safety upon the car, and while standing on the running board of a summer car, the latter immediately started with a jerk, thereby throwing the child under the car and crushing his leg.

Held, that a verdict for plaintiff will be sustained, though such evidence rests solely on the testimony of the child's attendant.

A. Kersloot v. *Second Avenue Ry. Co.*, N. Y. C. A., March 1, 1892. *Note:* This was not a unanimous decision. Finch and Gray, J. J. dissent. Sec. 8 N. Y. Supp. 926.

The Street Railways of New York City.

By W. N. Amory.

An analysis of the Reports of Street Surface Railroads of New York City, as they appear in the New York Railroad Commissioners' Report for 1891, presents an interesting array of figures.

The number of railroads operated is fourteen, counting a lessee railroad with its lessors is each case as but one. The total length of double track railway, including switches, turnouts and sidings owned or operated by these companies, is 138.28 miles. The total capital stock authorized by law or charter is $30,350,000. The total funded debt is $33,642,000. The grand total is $63,992,000. The average capital stock per mile of double track is $219,472; the average funded debt is $243,278 per mile of double track; and the average of capital stock and funded debt combined is $462,750 per mile of double track. The New York & Harlem Railroad Co. (the Madison Avenue line) is stocked at the rate of $1,132,500 and its funded indebtedness is at the rate of $1,359,570 per mile of double track, which is far above the average of the other railroads. Omitting the New York & Harlem Railroad Co., the average capital stock for all these railroads per mile of double track is $157,196 and the average funded debt, $167,060, making an average total of $324,256 per mile of double track, including switches, turnouts and sidings.

The total cost of roads and equipments is given as $53,260,598, of which $5,493,271 is for equipments and $47,767,327 is for roadbed, superstructure, right of way, real estate, building, fixtures, etc. On these figures the average complete cost per mile of double track railroad is shown to be $312,820; and omitting the New York & Harlem Railroad Co.

The total number of passengers carried for the year was 226,650,615. This is an average *per diem* of 629,157 passengers. The average receipts from passengers *per diem* were over $31,000. Taking the population of New York at 1,800,000, each inhabitant rode on surface railroads 127 times during the year, and spent $6.35 for car fares on surface roads. The average number of passengers carried per mile of double track was 1,660,694; thus a road of five miles of double track on the average would carry over 8,000,000 passengers yearly.

The gross earnings from operations were $11,361,229. The operating expenses (excluding all taxes) were $8,048,085. The percentage of operating expenses to gross earnings from operations was 70.83 per cent. The operating expenses of one company were as low as 57 per cent., while another's reached 99 per cent.

The percentage of gross expenses, including cost of operation, payment of taxes, rent, interest, etc., to gross income from all sources (omitting the New York & Harlem Railroad Co.), was 88.34 per cent.

The average full cost of carrying a passenger was 4.42 cents, leaving but a little more than half a cent net profit on each passenger carried.

The income from all sources was $10,628,545. The deductions from gross income, being expenses of every nature, were $9,407,516. The net profits remaining were $1,221,029, applicable to dividends on capital stock. These last figures do not include the New York & Harlem Railroad Co., which being very heavily over-bonded did not, after paying operating expenses, earn the interest on its funded debt, but did declare a small dividend, although had this company been stocked and bonded at an average rate it would not only have paid the interest on its funded debt, but would have earned besides a handsome dividend on its capital stock. The average amount of dividends earned on capital stock (omitting the New York & Harlem Railroad Co.) was 6 per cent. The average of dividends declared was a little more than 5 per cent. on total amount of authorized capital stock.

The total number of employes, including officials (estimated in the case of one company) was 7,991. Total number of horses, 15,805; total number of cars, 2,420. This is an average of a little more than six horses to a car, while the average number of cars per mile of double track is seventeen. The number of accidents reported was 132, of which twenty were fatal. Of the twenty persons killed, ten were passengers.

In this connection a brief examination of the report of the Manhattan elevated roads also may prove interesting. The capital stock of the elevated roads authorized by law or charter amounts to $30,000,000. The amount of funded debt authorized is $40,000,000, a total of $70,000,000. The total of double track road, including all sidings, turnouts and branches is 45.05 miles. The total length of double track roads, exclusive of branches, turnouts, sidings and switches, is 37.07 miles. The average capital stock per mile of double track road is $809,280. The average funded debt authorized per mile of double track road is $1,079,040, making a total of $1,888,320. The gross earnings for the year from operation were $9,846,710; the operating expenses (excluding all taxes) were $4,975,141; the net earnings from operations were $4,871,569. The cost of operation was 50.53 per cent. of earnings. The number of passengers carried during the year was 196,714,199. This is a daily average of 538,943 passengers. The total number of accidents for the year was twenty-nine. There were but four passengers killed and one injured, which is a wonderfully good record. Of employes eighteen were injured and six killed. No railroad now built and operated has made a record that can be compared with that of the New York elevated railroad in this respect.

The elevated railroad tickets are exactly two inches in length. If the tickets sold in one day were stretched along the track they would reach from South Ferry to the terminus of the Third Avenue line and back again to South Ferry, as there are more than seventeen miles of elevated railroad tickets purchased every day by passengers and dropped in the chopping boxes.

World's Fair Notes.

The French steamship line, Havre to New York, has agreed to return free all exhibits which it brings to the Exposition at regular tariff rates.

The Canadian Pacific Railway will exhibit at the Fair a model passenger train, and also models of the fine ocean steamers in that company's service.

A bill protecting foreign exhibitors of patented articles from all possible prosecution for infringement has been passed by the Senate, and is pending and reported sure to pass in the House. The bill reads: "That no citizen of any country shall be held liable for the infringement of any patent granted by the United States or any trade mark registered in the United States where the act complained of is performed in connection with the exhibition of any article or thing at the World's Columbian Exposition at Chicago."

Bids for furnishing the generating apparatus for the electric power plant to be used at Jackson Park, have been opened. The Eddy Electric Manufacturing Co., of Connecticut, offered to furnish the 300 H. P. generating apparatus for the Transportation Building free of cost. The National Electric Manufacturing Co., of Eau Claire, Wis., offered to furnish the apparatus for this building for $2,500. The Mather Electric Co., of Manchester, Conn., bid on the Mines Building, and offered to furnish 600 H. P. for $2,450. The Thomson-Houston company's bid for furnishing all the apparatus aggregated $52,900.

The Short Electric Railway Co., through their Seattle agents, Chas. H. Baker & Co., have secured the contract for line equipment and cars for the Third Street line in Seattle. There will be six St. Louis cars equipped with two 20 H. P. Short single reduction motors each, and the road will open in about ninety days. This line is the property of the Rainier Power & Railway Co.

The Midland Electric Street Railway, which connects with the St. Louis & Suburban line, was put in operation last month.

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JAS. H. McGRAW, Managing Editor. C. B. FAIRCHILD, Editor.
C. E. STUMP, Business Manager. H. W. BLAKE, Associate Editor.
H. W. POOL, Advertising Department.

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We heartily invite correspondence upon all subjects of interest to street railway men. Information regarding changes of officers, new equipment, extensions, etc., will be greatly appreciated for our official directory and news columns. We especially invite the co-operation of all interested to furnish us particulars that the directory may be correct and of the greatest possible value.

Address all communications to

Street Railway Publishing Co.,
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Track Construction for Street Railways is constantly tending toward the standard established by steam railroads. This tendency is illustrated very strikingly in Milwaukee, where the belief that construction cannot be too good, has taken strong hold. A general view of the work which is being done on the comprehensive system in that city is presented in this issue.

A More Senseless Proposition can hardly be imagined than that embodied in a bill before Congress which empowers the District Commissioners to designate the number and headway of cars which shall be run on the various street railway lines of Washington at different hours. This is only a step towards a transfer of management of this most important industry from the hands of the owners, who by long experience are supposed to know best how to conduct the business in the best interest of the patrons as well as owners, to those of men inexperienced in the business, and who are already overburdened with other duties.

The Objectionable Features contained in the city ordinance granting a franchise to the Union Railway Co., of Providence, R. I., which, as we stated editorially in our last issue, prevented the sale of new bonds, has been removed or rather amended by the action of the legislature which extends the franchise for twenty years and makes such conditions as seem to be satisfactory both to the railroad company and city authorities. The provision in the franchise that the city, after ninety days' notice, may order up the rails in certain streets, is retained, but it is stipulated that the company shall be given another location as nearly similar in public convenience as possible whereon to use and operate their tracks.

Interesting Statistics relating to the operation of the street car and elevated lines in New York City will be found in another column. This matter has been compiled with great care from the last published reports of the Board of Railroad Commissioners of the state, and is in shape to be readily understood. It will serve as a standard by which persons interested in the operation of lines in other cities will be able to determine the relative economy with which their own lines are being operated, and will prove valuable matter to the student of industrial progress. One remarkable feature in connection with the operation of the elevated lines, which reflects great credit upon the management, is the very small number of accidents that have occurred. This fact is emphasized when the enormous number of passengers transported daily is considered, and, as an aid in comprehending this, it is stated that if the number of tickets (each being two inches long) which are sold daily were placed end to end they would extend over a line more than seventeen miles in length.

The World's Fair at Chicago will offer to the manufacturers of street railway apparatus and appliances an excellent opportunity to show their latest products to the many visitors interested in street railways who are certain to attend the Fair both from this country and abroad. To learn just what steps have been taken in the line of individual exhibits, we recently sent a letter to the principal manufacturers of street railway apparatus asking whether an exhibit would be made, and if not, the reasons for not doing so. The replies received show that a hearty interest in the Fair is being generally felt, and that many manufacturers have already secured space or have applied for it, while nearly all expect to have an exhibit. To those who have as yet made no arrangement for space, and who contemplate so doing, we would urge the desirability of early action. Applications for space may be addressed to Willard A. Smith, chief of the transportation exhibits. Geo. W. Pearson, president of the Metropolitan Railroad Co., Washington, is chairman of the World's Fair Committee, appointed by the American Street Railway Association.

The Operation of the Elevated Road in Chicago, which will begin the present month, will mark the date of a new era in transportation. While the line will ultimately reach the World's Fair grounds, only a four mile section of the road is to be operated at present. The elevated system will doubtless relieve to a certain extent the congested condition of affairs which has been heretofore referred to in these columns, but while the road parallels one of the cable lines on the South Side it is not thought it will seriously injure the business of the latter. That this is the general impression is indicated by the fact that the stock of the cable company has been rapidly rising in value for several months, and the advance is still in progress. At the same time investors seem to be confident of the success of the elevated company, for their stock reached par before the rolling equipment reached the city. This fact is considered almost without a precedent. As to the capacity of the road, the officers say the facilities are sufficient to transport 12,000 passengers an hour from the downtown terminus. The elevated structure is all that could be desired both in point of strength and in the matter of appearance; the rolling stock is of the very latest design, and the management includes men who have had extended experience in connection with elevated roads. The new enterprise will undoubtedly prove

successful financially, and will add immensely to the intramural transportation facilities of the city.

The Cable is Performing Splendid Service in Chicago where it is called upon to meet an extraordinary demand for transportation facilities. The city up to the present time has been obliged to depend wholly upon the cable systems for rapid transit, and while the companies have been unusually enterprising in their willingness to make improvements, they have been almost overwhelmed by the vast increase in local travel. The demand has been such that the several power stations in two divisions of the city have been furnishing power almost to the extreme limit of their capacity. Work is now in progress for doubling their engine capacity, and brief statements of the improvements are presented elsewhere in this issue. Chicago street railway men are, almost without exception, thorough believers in the cable. They believe it has been a mighty factor in building up the city and their statement would not be materially different from that of a writer of a magazine article, which appeared last month, who says in speaking of the development of transportation facilities in Chicago: "Horse car lines have been used for many years, but the phenomenal growth of Chicago dates from the changing of these lines to cable lines, some six or seven years since." In their opinion this system only is adequate to cope with the crowds which assail the cars in a business district which is extremely contracted. Still they do not deny that electricity may be employed to great advantage at points where the traffic is not so great; in fact, it seems to be the general opinion that when cable is introduced on all the main lines, and when electricity is installed on all subordinate lines, Chicago will be provided with as complete a system of rapid transit as can be furnished by surface cars.

A Sympathetic Strike, so called, forces home to the minds of all those engaged in the employment or management of labor the conviction that there is something radically wrong in the present "scheme of things." An ordinary strike, where it relates to a single industry, is serious enough even though it does not affect the public, but where a large body of men become suddenly arrayed against their employers, especially when the work on which they are engaged is of a public character, the consequences become disastrous and far reaching. A case in point is where thousands of pavers and granite handlers in New York, Brooklyn and other cities have quit work, not that they had any particular grievance, but merely because they sympathized with their fellow workmen the granite cutters and quarrymen of New England where a lockout had been ordered. The reason for the lockout was not one of wages but because the employers wished to substitute January 1 for May 1 as the time for arranging the scale of wages for the ensuing year because their contracts were usually closed before May 1, and it thus became necessary for them to determine the scale of wages as a basis on which to take contracts. The men objected to the change, claiming that work being peculiarly slack at the beginning of the year, the employers would be better able to dictate their own terms. What makes the matter especially serious is not that so many men are idle, but it is the stoppage of many public works, particularly that of street paving in New York, where a large number of streets are in the hands of the contractors, many of them being torn up, and paving blocks being stored along the curbs, much to the inconvenience of merchants and the operations of some of the street car lines. It would seem as if the time were ripe for some concerted general remedial action throughout the country to prevent, if not strikes, at least sympathizing strikes.

The Melbourne Method of raising money for building tramways, the plan on which the business is conducted and the financial results that have attended the operation of the cable lines in that city are worthy of the careful study of all parties who are interested in the vast rapid transit schemes with which the authorities of several of our largest cities are now wrestling. For this reason we give in another column an article which explains quite fully the relation between the Tramway Trust and the Tramway Co., together with the amount invested, and the income thus far secured. The Tramway Trust is composed of members selected from the councillors by the municipal corporations of Melbourne and the various suburban towns through which the lines pass. This trust borrowed money in London at 4½ per cent. with which to build the lines, and as soon as they were finished and fully equipped they were turned over to the Tramway Co., an association of business men which undertakes to operate the lines under a thirty years' lease. The capital of the Tramway Co. is represented by stock, and now amounts to $2,332,800, about half of it being what is termed watered stock, for which the original shareholders paid nothing. The first charges on the profits of the Tramway Co. from the operation of the lines is the interest paid to the Tramway Trust on the original borrowed money, and a sinking fund sufficient to pay off the entire amount at the end of the thirty years. The balance of the profits is available for dividends among the shareholders of the Tramway Co. At the expiration of the lease (thirty years) the entire system including the engine houses, real estate and equipments reverts to the Tramway Trust (virtually the corporations of Melbourne and surrounding towns) without cost. So profitable has been the operation of the system, which includes forty-three miles of double track cable lines and three miles horse lines, that the operating company is paying 20 per cent. per annum on the watered stock even, and one year on the old stock, before the amount was increased, it paid 72 per cent. The article shows that the cost of construction per mile of double track including the full equipment was $179,820. Not only is the system a profitable one to the moneyed investors, but so far as we can learn it is admirably managed and the lines are operated to the entire satisfaction of the traveling public.

The Advantage of Good Pavements in city streets, especially along the lines of street cars, is not as fully appreciated in this country as it is in the cities of Europe, although the necessity of good pavements is quite as great here as it is in most of the foreign cities. In some localities, however, our people are waking up to the importance of this subject, and have become convinced that it is economical to lay and maintain good pavements on city thoroughfares. Wherever a beginning has been made the evidence is conclusive that good pavements not only benefit those actively engaged in commercial pursuits and the abutting property owners by increased values and rents, but they have added largely to the general welfare

in the way of sanitation and public health. We say good pavements, for pavements so called are not a new thing in any of our large cities, but the result of inferior pavements has been a great tax on business men, a waste of labor and loss of time and wear of public vehicles. In contemplating improvements of this kind, however, careful study should be given to determine the character and quality of pavements which are best suited to the varying conditions of street traffic in order to secure the best results. Generally, for streets subject to very heavy traffic, stone block pavements laid on a concrete foundation and grouted with tar and gravel are the most durable, the material being granite, trap rock, or sandstone rated in the order stated. For streets where the traffic is less heavy, the same class of pavements, laid on a sand foundation and grouted with sand, may be employed, while on residential streets, where the traffic is comparatively light, asphalt, or vitrified brick pavements, are the best. Detailed methods of construction with the cost of different types of pavements, will be found in another column.

* * * *

In this connection considerable attention should be given to the relation which the car tracks bear to the street pavement of which they form a part, for when these are out of repair they are just so much defective pavement. Heretofore, when animal traction only was employed, it has been the custom in granting street railway franchises to require that the operating companies pave between and for a short distance just outside the tracks and keep the same in repair. Such a regulation was allowable under the old method of animal traction, cobble pavements and inferior track construction, because these portions were rapidly worn by the incessant tramping of the animals, but with the new methods and more substantial construction it is not a proper regulation, and should not be incorporated as a condition in a franchise. In order to secure good pavements the city authorities should construct and maintain the entire pavement outside and between the rails, and should keep full authority and absolute control over them, and should make all repairs whenever the pavement is necessarily disturbed by the operating company. Unless this is the case there will be more or less conflict between the companies and the public works department in any attempt to compel the former to conform their tracks to an established grade or to lay and maintain in and about their tracks pavements of as good quality as those laid by the city. In case a change in grade or in pavement is necessary, the city should bear the cost, but if it is thought desirable to require that the railway companies bear part of the expense, this is better collected in the way of a tax. It is not necessary in order to secure this desirable end that the city own and maintain the street railway tracks and lease them to the operating companies as is the custom abroad, but we think a regulation to this effect should be incorporated in every franchise where the line is to be mechanically operated, and if necessary a stipulation should be made in regard to employing a rail with good paving qualities. Not only do good pavements and a suitable rail benefit the public, but they are of advantage to the operating company as well, for if, owing to suitable construction, it is easy for vehicles to get in and out of the line of tracks, drivers of these vehicles will not attempt to hold the right of way and thus detain the cars, but will more readily turn out, thus giving more headway for the street cars.

The Vital Test will be given the plans of the New York Rapid Transit Commission when the franchise is offered for sale. If capitalists come forward and undertake the contract, then such a road as has been laid out by the Rapid Transit Commission will undoubtedly be built. Can the money be found to build and equip such a road, it being granted that it will cost several million dollars per mile? Manifestly not; hence from this point of view the labors of the commission must go for naught. The whole thing is a kind of farce that reminds one very much of the experience of a would be soldier who was very anxious to enlist during the war. He presented himself for examination before an army surgeon who, as he says, examined him interiorly and anteriorly, fore and aft, but the very thing for which he was rejected—for he was rejected—his eyes, the surgeon could have seen at first, were defective. We would not in any way reflect upon the commissioners, for their labors have been ably and conscientiously performed, and with a strict regard to the law as interpreted by the best legal talent, and were doubtless necessary to prove conclusively to the public (who are supposed to be adverse to the development of the elevated system) that the plans are *not feasible.* Some little time must yet elapse before a point is reached when all will know what can be done or until the programme of the commissioners is fully developed.

* * * *

The work already accomplished, as appears from their report, is about as follows: Having considered every possible plan, they were inclined to favor, first, an open air solid viaduct road, but this plan was abandoned owing to the excessive costs of right of way. The next choice was for an elevated system through the streets, but from fear of public clamor, and because Broadway below Thirty-fourth Street and certain other streets are especially exempted by law from such use, they did not dare to recommend this means of rapid transit. There then remained a choice between a deep tunnel road through the solid rock, and a shallow tunnel road as near to the surface of the street as practicable. A choice of the latter was finally made and for the main line a route up Broadway continuing up the Boulevard and more or less directly to the city limits on the west side was adopted. An east side line was also laid out, a part of which has since been exempted by an act of the legislature. The general plans were then submitted, as required by law, to the city authorities and by them approved in October last. In addition, the Rapid Transit Act required that the consents of a majority of the property owners along the whole line, and the amount of a majority in value of property bounding that portion of each particular street along which the proposed railway was to run, should be obtained. After making a complete canvass it was found that a consent of a majority of owners on each street could not be obtained. In case of such failure, however, the Act and Constitution allow of making application to the Supreme Court of the State for the appointment of three commissioners, who, after due hearing of all interested parties, shall decide whether the proposed road shall be constructed or not. This application was made and a commission composed of gentlemen of the highest standing was appointed. This commission is at present sitting and apparently is near the point of reaching a conclusion. Their report, which is to be made direct to the Supreme Court, will doubtless be favorable to the plans of the Rapid Transit Commission, and when confirmed by the court is

to be taken in lieu of the consents of the property owners. When such approval by the court is made, the Rapid Transit Commission may prepare more detailed plans for construction and operation, and seek capital for their consummation or offer the franchise for sale. The result, as indicated above, is already anticipated and the commissioners must either resign and a new commission be appointed or they must continue in office and lay out a complete, adequate and comprehensive elevated system with the present system as a basis. If the laws at present exempt any necessary portion of the routes required, then the laws must and will be changed. The demands are imperative, and a complete elevated system, as we have advocated from the start, must be undertaken and pushed with all speed to its final completion. As a beginning, additional facilities should be granted to the management of the present elevated railroads. Let them have the loop around Battery Park with or without price and sufficient room at City Hall Park. Allow them to lay a third track for express trains on their present structures. Allow or require them to widen the present stairways and give such other facilities as it is possible to give that would serve the convenience and comfort of the traveling public and would not be burdensome upon the company. We trust that it will take only a few months longer to convince everyone beyond question that nothing is left for adoption but an elevated railway system.

The Real Root of Mal-administration, such as we often see in anti-corporation legislative bills,is the tendency of legislators to vote in accordance with what they suppose to be popular prejudice against corporations, a prejudice founded upon the old superstition of corporations having no souls. On what this blind charge, or prejudice against corporations is founded, is not made manifest, for there are no facts, so far as we are able to learn, in its justification. Corporations, as a class, have just as much "soul" as any business firm, that is they have just as much consideration for their employes, which is the supposed interpretation of the idea of "a soul" in these cases. The issue of providing for the well being of employes is a strictly business matter, and the subject of feeling, is not necessarily allied with it. If a firm or corporation cannot see that its interests are more or less identified with its employes, and makes no provision for their suitable comfort, it is a mark of short sightedness rather than any want of consideration or soul. The best corporations are always prudent in such matters, and we have yet to learn that there is any worse management among corporations in the described particular than among any other forms of business organization. Therefore, if there is no further cause of animosity, the hostile legislative acts referred to are a gross injustice which ought to cease without unnecessary delay. Mr. G. Hilton Scribner in one of his papers before the American Street Railway Association clearly shows that no sooner is a corporation established, than it is stigmatized as a monopoly, and the state, instead of protecting its own acts in the franchise permitting the corporation to do business, through a majority of its legislators, restricts, hampers and unjustly obstructs the very acts which the state granted permission to do. Just as Mr. Scribner says, the state should either do one thing or the other, and not stultify itself by inconsistencies which are altogether outside of the most ordinary kinds of common justice. It is admitted that many of the adverse acts of legislators, acts which wholly antagonize preceding laws, are the work of the other party, which other party pretends to oppose everything not done by its party, on principle. This particular, undoubtedly, is one of the prime causes of many legislative absurdities ; and so serious has it become in the national as well as the state governments, that frequently the charge is justified that partisanship is of more consequence to the state than justice. Partyism may have its good uses, but certainly opposition to just acts, merely because those acts are the work of the other side, is not among them. It would seem an excellent plan for the legislature to appoint one individual at least, whose time should be devoted to the exposure in Congress, or the legislature, of all attempts to do what nullifies any preceding business of the assembly. Of course, we have no reference to amendments to laws, or any other regular work where improvement in government usages is possible. We allude to cases where the act or bill under consideration falsifies preceding acts, either in their spirit or their letter without the full knowledge of all members. If there should be such an individual or if some legislator took upon himself such a post, which might be likened to that of a legislative policeman, there would be plenty of business to be done. For it must be confessed that many anti-corporation bills pass through the legislature without any particular comprehension of the subject on the part of the legislative voters. This is due to the enormous amount of work required of the average legislator, in order that he may have a thorough comprehension of the questions up for debate ; in consequence many vote thoughtlessly, or because a friend votes that way, a matter which might be checked almost entirely, if a conscientious legislator, such as we described exposed any contradiction in the proposed legislation of the original act permitting a corporation to do business in a specified way. Consistency is lauded high enough, but its average application in legislative halls, yields sufficient food for wonderment to keep a student of political economy busy about all his life ; and we strongly suspect that this state of things is more due to ignorance, than any direct thought to stultify preceding conduct. But as matters rest, what is everybody's business is nobody's business, and those among the legislators who observe such contradictions, think, perhaps, that it is none of their "pic-nic," so allow the act to go on record unchallenged. A striking feature of this anti-corporation legislation is the sudden way in which many bills are passed through both Houses, as if a conspiracy was afoot ; or, that the supporters of the movement really feared to have too much attention drawn toward what they were doing. There are many cases where the outside public hardly hear the matter mentioned until it is in the hands of the governor for signature. Improper bills, for some unexplained reason, possess a remarkable amount of haste in procedure, and unless the legislator is constantly on his guard, he finds himself committed in support of a measure which he often confesses that he had not properly considered.

What becomes of worn out street railway cables, is a question often asked. The most extensive use to which the old cables have been put is in the manufacture of wire nails. This is not done in this country, but the old cables are sent to China and Japan, where the wires are untwisted and the nails cut and formed by young boys and girls, who beat them out cold on little anvils with small hammers. Many of these wire nails are used in tea chests, and the old wire comes again to this country through this means.

Our New Book Ready.

"Street Railways (Trams): A Practical Handbook for the Use of Street Railway Men," will be ready July 1. We trust the book will contain all its title promises and more. It illustrates with about six hundred engravings the mechanical designs that are employed in this particular industry, as well as giving incidentally a great deal of historical matter, while it is to a large extent made up of the actual practice of the most successful street railway men and those of kindred industries, and thus becomes a safe guide to beginners and in fact to all who are in any way engaged in this most important field.

In its preparation the author has enlisted the service as co-workers of many of the most prominent engineers and practical men interested in the business in this and other lands, for which our hearty thanks are due. It is true in every industry, and especially in this, that the knowledge that is of most worth is that which relates to the practical experience of reliable men, whether their experience resulted in success or failure, and when we know the history of a device, or a method of construction and management, and the views of the men who employed them, and the circumstances under which their views were formed, we have a safe guide in planning for the desired end, without the expense of experimenting. Hence the the object of the work is helpful, for it is intended to assist inquiring minds towards a right understanding of the business in all its details, and in a right selection of the best appliances to be employed.

Instead of affixing in all cases a positive endorsement to certain devices and methods it has been thought better to furnish the inquirer with the means of doing so for himself by showing the origin of the design, how it is constructed, and how it has been employed. In like manner the different chapters have not been written with a view of advocating any particular system of traction, but rather with a view of leading to free inquiry, extended inspection and careful selection as the surest course for determining the system best suited under the conditions imposed.

The work covers every department of the entire street railway field, and the matter is presented in thirteen chapters with an appendix. The different chapters treat fully of electric, cable, horse and other surface roads, including those operated by steam and gas motors, also of incline planes, rack rail systems and elevated roads. The matter relating to electric railways explains in a simple manner the theory of electric phenonema so much as is necessary for any one to know in order to fully understand how this subtle fluid is harnessed and made to do mechanical service. One chapter is devoted to car building, which treats not only of methods of construction and decoration but also of car shops and gives particulars relating to some of the allied industries such as the manufacture of wheels and axles. Another chapter treats of track construction in all its details, particular attention being given to methods of paving. The other chapters, in their order, relate to discipline, with an elaborate code of rules for the guidance of conductors and drivers; franchises, with corporation laws relating to the same; accounts which explain the best method of classifying the operating expenses of a street railway line, giving valuable forms to serve as models for ruling the journal and cash book; auxiliary appliances, which is an illustrated chapter without matter, in which a large number of track and other appliances are presented; an appendix which contains matter relating to such electrical motors as have come into prominent service since the first chapter was prepared.

The price of the book will be $4.00, and it is designed for use not only by superintendents, managers and engineers, but also for the foremen and assistants of all the different departments; for such employes as may wish to perfect themselves for higher positions, and for the student of economic subjects.

WE are in receipt of an ornamental glass paper weight from the Reliable Manufacturing Co. of Boston. We find it a useful addition to our "kit" of tools.

St. Louis Notes.

The bill authorizing the Cass Avenue & Fair Grounds Railway, which includes the company of that name as well as the Northern Central and Union railways, to change its motive power from horses to electricity, was passed some time ago by the City Council. There were several amendments to the original bill, one of which requires the company to run all its cars from terminus to terminus, not allowing any special schedule for extension, and another compelling the lines to start the cars from their western terminus not later than 5.30 A. M. The bill met with opposition at first, but for some reason or other was suddenly passed, to the surprise of all. Reconstruction of the roadbed was commenced on May 16, more than five hundred men being employed to do the work. A large amount of grading will have to be done on part of the line. We were told by an official of the road that the Johnson girder rail would most likely be employed. 5,000 tons of seventy-eight pound girder rail will be required. The power house will be situated where the present Northern Central car sheds and stables are located, fronting on North Market Street, and running from Spring Avenue to Prairie Avenue. The electric system to be used has not yet been decided upon. The present intention is to make 1,000 H. P. the engine unit, and have each one of these drive two 500 H. P. generators. The company contemplate having the entire system finished in September of the present year. The estimated cost is $1,800,000.

The Lindell Railway Co. has had introduced into the City Council a bill for granting a franchise to the Compton Heights, Union Depot, & Merchants' Terminal Railway. This is the most important railroad bill now before the council. If the franchise is granted, as in all likelihood it will be, the Central Electric Railway, another newly organized company, will be headed off. The eastern terminus of the road is in the vicinity of two new railroad passenger stations and several freight depots, a most important district. The route makes a direct short cut to the southwestern part of the city, and, in consequence, a great deal of opposition is expected from the several competing lines which reach this territory indirectly. Almost all the travel to the new Union Depot from the business and residence districts will go by this line, as it is the most direct. The cost of building the road is placed at $700,000. Everything towards its equipment will be first class in all respects. The promoters agree to have the road finished east of Grand Avenue in eight months. As soon as Van Deventer Avenue is cut through, the line running on that street will connect with the new road, and thus make a continuous route from Tower Grove Park and the Fair Grounds. For many reasons the franchise cannot be granted without some deliberation on the part of the City Council.

Several months ago a bill was passed by the City Council empowering the St. Louis Railroad Co. to operate the St. Louis & Baden Railway, running to Baden, at the extreme northern limits of the city, and operate the road by electricity. It appears now that Capt. McCulloch refuses to accept the franchise, on account of certain provisions contained in it. If the arrangement were effected by the two railroad companies any one would be able to ride about twelve miles for five cents.

The Bellefontaine Railway began the operation of its cars by electricity on April 30. Until May 6, current was derived from a 350 H. P. Thomson-Houston multipolar generator at the plant of the Municipal Electric Light & Power Co., but the company's power station being now sufficiently completed, current is obtained therefrom. There is at present installed one 600 H. P. engine operating two "M. P. 250," four pole type, Thomson-Houston generators, of 275 H. P. each. The company has in operation about forty cars. Of these four are eight wheelers. Each car is equipped with two 15 H. P. Thomson-Houston S. R. G. motors.

A flywheel recently burst in the power station of the Union Depot Railway, doing considerable damage. Some of the machinery was disabled by the flying pieces, but,

fortunately, no one was hurt. The wheel was eight feet in diameter, and very heavy.

At first little confidence was shown in the electric road to run between St. Louis and Chicago. The scheme is said to be now assured, the surveys being finished, and the construction of the bridges and viaducts having commenced. The road will cross steam railways at twenty different points by means of bridges. The approaches to each bridge will be 1,000 ft. in length. All of the 246 highways crossing the road will each be provided with a viaduct, having an approach of 246 ft. The motor to be used is of a new design, brought out by Dr. Wellington Adams, the company's electrician, and will be placed on the axle of the driving wheels, each of which is to be six feet and a half in diameter. The speed will not be controlled by means of the ordinary switch used on street railways, but by means of a new device, the invention of Dr. Adams, and the details of which he would not divulge. Terminals have been secured in both St. Louis and Chicago. The route between the two cities is only 248 miles long, thirty-six miles less than the shortest steam road. There will be no curves, and no grades except at steam railway crossings. Otherwise the road will be level. The contracts for the grading and track laying will be let shortly. It is expected to have the road finished in time for the World's Fair. S. L.

Washington Notes.

Among the bills relating to the operation of street cars in the District of Columbia which are at present before Congress, having passed the House, is one which prohibits the use of one horse cars within the limits of the city of Washington after January 1, 1893. The bill provides that after the above date all cars, if drawn by horse power, must be of the style known as two-horse cars, and each car shall be in the care of a conductor who shall not act as driver, and the penalty for violating the provision is fixed at $25 per day per car. In connection with this bill an amendment was adopted allowing street railway companies to equip such portions of their lines as were outside the city limits with the trolley system.

A second bill requires that all street railway companies operating in the District of Columbia must file with the Commissioners of the District a schedule to be approved of by the Commissioners, according to which the cars of each company shall be operated, which shall show the number and character of the cars in use, the kind of power used for their operation, the number of trips per day for each car and the length of time between the cars at each hour of the day or night when such cars are being run. The District Commissioners are anthorized to revise and alter the requirements fixed in the schedule whenever, in their judgment, the reasonable demands of the public service may require it. The Commissioners are to satisfy themselves that the number and quality of cars provided, and the time on which they are to be run, as well as the management of the same when being run, gives ample and proper accommodation to the patrons of the road. As a penalty for violating this act which is to take effect thirty days after its passage, the company are subject to a fine of $100 per day for every day the violation continues. In considering the measure the House rejected a "no seat no fare" amendment that was offered, and also an amendment requiring the street railway companies to provide shelter for the "tow boys" at the different hill stations.

The Washington & Georgetown Railroad Co. have recently paid to the District Commissioners a check of over $61,000 in settlement of an old judgment against the railroad company, which was gained by the District in 1884. In the same connection a claim of $200,000 was made against the Metropolitan Railway Co., and they were given eighteen months to settle.

These claims, which are now nearly twenty years old, were for the payment of work done by the Board of Public Works on the streets along which the lines of the railroad companies operate. The companies contested the claims before all the lower courts, and finally the case was tried by the Supreme Court of the United States, which rendered a decision in favor of the companies, but in face of this Congress attached a provision to the general deficiency bill in the last days of the last session requiring the companies to pay the same with interest. In considering the question no opportunity was given the companies to be heard. The above bills show that the position of a street railway company in the District of Columbia, subject to the erratic action of Congress, is not an enviable one.

The Lynn & Boston Electric Equipment.

In the summer of 1888, before the West End Street Railway Co., of Boston, had decided upon the adoption of electric power upon their system, the Lynn & Boston Railway Co. were experimenting with electric motors for surface railway use, and had a car in operation on the Crescent Beach branch of their system. This was the first Thomson-Houston street car ever put into regular commercial service, and to the officials of the railway company belongs the credit of thus early recognizing the advantages of electricity for street car propulsion.

In spite of this early use of electric power the Lynn & Boston Railway Co., have only recently decided upon its adoption upon their complete system. Work is now being rapidly pushed upon all parts of the equipment, and the company hope to have in operation by September of this year their main line which extends between Boston and Lynn by the way of the old Salem turnpike. The company have in all about sixty miles of track, embracing a comparatively large section of country from Boston east to Marblehead and Peabody, including the cities of Lynn and Chelsea, and smaller places.

Two power stations are being built, each of which will have an ultimate capacity of 5,000 H. P., one being in Lynn on the Martin Wharf property, Washington Street, and the other in Chelsea at Pratt's Wharf. The stations, which were designed by L. H. McIntire, consulting engineer of the road, will be practically identical in exterior appearance and internal arrangement. Being on tide water, the facilities for receipt of fuel are the best, and salt water will be used for condensing purposes. The stations will be of brick with granite trimmings, buttressed walls and monitor roof. The engine room of each is 150 x 68 ft., occupying the front of the building. The engines are four in number at each station, from the works of the Watts-Campbell Co., of Newark, N. J. The boilers will be supplied by the Babcock & Wilcox Co., and will be of 1,500 H. P., aggregate capacity, in three batteries of 500 H. P. each for each station. The condensers will be furnished by the Watts-Campbell Co., the pumps by the Deane Co. of Holyoke, and the engines for operating the condenser by C. & G. Cooper & Co, of Mount Vernon, O. The piston rod packing for all engines will be furnished by the Tripp Manufacturing Co., of Boston.

The generators will be of the Thomson-Houston four pole type and will have a capacity of 300,000 watts. They will be belted directly to the engines by thirty-six inch belts.

The cars will be of the sixteen foot type and will be built by the Lynn & Boston Railway Co. themselves. Each of the motor cars will be equipped with two Thomson-Houston waterproof, fifteen H. P. motors. For track construction the company are employing seventy pound girder rail The overhead construction has now been almost completed on the main line between Lynn and Boston. For the greater part of this distance wooden poles supplied by Geo. McQueston & Co. of Boston have been employed. Within the city limits of Lynn iron poles have been used to a large extent. At the Boston terminus of the line the company will run over the West End Street Railway Co.'s tracks and will use their power.

The company anticipate a large increase in traffic with the change of motive power, and will probably do considerable business in the transportation of light freight in addition to their passenger traffic. They are satisfied that they can carry light freight not only more quickly and promptly than by the present methods, but also at a cheaper rate.

Views in the Works of the Lewis & Fowler Manufacturing Co.

In this country of over 60,000,000 of inhabitants the percentage who have never ridden on or seen a street car must be almost insignificant. To many, the street car furnishes the regular means of transit between their places of business and their homes, yet, how few among this number—how few even among street railway men themselves—realize the amount of designing and detail work, and the number of operations through which each piece must be put before the entire car is finally completed.

As undoubtedly many of our readers have probably never visited the interior of every department of a car factory, the following description of the extensive works of the Lewis & Fowler Manufacturing Co., of Brooklyn, will not be without interest.

Like many other important enterprises, this company began business in a modest way, Mr. Daniel F. Lewis and Mr. John W. Fowler, who had both long been connected with the Brooklyn City Railroad Co., being the promoters. The business grew so rapidly, that it soon became evident that it required the undivided time and attention of either one or the other, and changing from a firm to a corporation the important office of president fell to Mr. Fowler. This gentleman resigning from the employ of the Brooklyn City Railroad Co., assumed the entire management of the business, and to his practical experience and energy is largely due the success attained by the company.

The company's first shop, after their incorporation in 1883, was a small building at No. 8 Columbia Heights, and their total force of employes numbered but fifteen men. The present works are located on Walworth Street, Brooklyn, between Park and Flushing Avenues, and extend through two blocks to Nostrand Avenue, covering in all thirty-six city lots of 25 x 100 ft.

Commencing at the Walworth Street end of the works is a substantial brick structure about 50 x 125 ft. and four stories in height. In this building are the offices, machine shop, register and brass finishing departments, stove department and buffing room.

The machine shop, part of which is shown in Fig. 1, occupies a large, well lighted room on the ground floor,

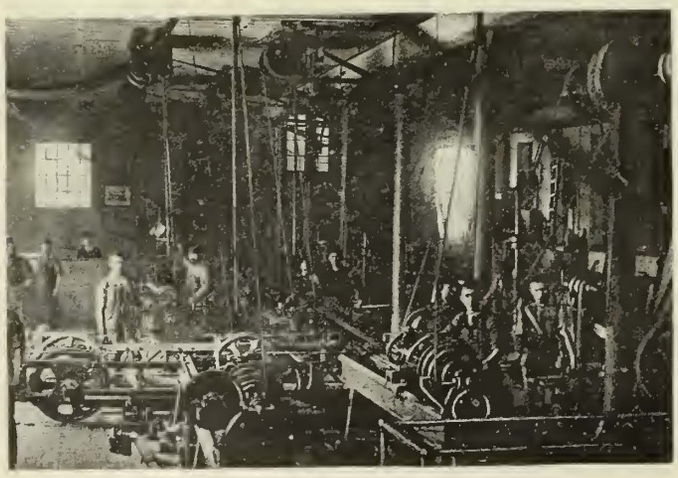


Fig. 1.—Machine Shop.

measuring 50 x 125 ft. In this department are lathes, planers, drills, etc., of the latest type which are used in finishing every class of iron work used in street car construction. There is also a large hydraulic wheel press of 150 tons pressure capacity. At one end of the room is a 75 H. P. Buckeye engine which furnishes power for the entire building. Friction clutches are provided, by means of which each department may be operated separately.

On the floor above are the well lighted and attractive offices of the company, the president and secretary being provided with private rooms. On this floor is also the draughting room.

From the offices we ascend to the floor above where are located the register and brass finishing departments, shown in Fig. 2. This room is 125 x 50 ft., and is provided with numerous windows which afford plenty of light for the delicate work necessary in the manufacture of fare registers. On the opposite side of the room is the brass finishing department. This department is thoroughly equipped with the machinery necessary for finishing the ornamental brass work used in trimming cars.

The stove department, illustrated in Fig. 3, occupies

Fig. 2.—Register and Brass Finishing Department.

one large room on the fourth floor, measuring about about 75 x 50 ft. This room is used entirely for the manufacture of street car heaters. On the same floor is the buffing room measuring about 50 x 50 ft.

At the rear of the building, and adjoining the machine shops is a building one story in height and about fifty feet wide, which extends through to Sanford St. Here are located the blacksmith shop, boiler room and brass foundries.

Fig. 4, gives a fair idea of the arrangement of the blacksmith shop. As will be seen, there are two rows of forges extending the entire length of the shop, with ample room between for handling the work. In this shop are also steam hammers and power machines for bending and straightening girder rails. Adjoining the blacksmith shop on the left is the boiler room. The boiler equipment consists of two horizontal tubular boilers of 125 H. P. capacity each, built by the Logan Iron Works. These boilers also furnish steam power for the wood-working shops which will be described later.

The iron foundry, which is at the rear of the blacksmith shop, occupies a space 125 x 40 ft., and is perfectly equipped with cranes for convenience in handling the material. The foundry is at present running about six tons per day.

Next comes the brass foundry, 40 x 15 ft. Here are cast all the hand rails, brake handles, register trimmings and ornamental work for interior car trimming. Only the best quality of English block tin, Lake copper and spelter are used. These last named departments are well lighted by large skylights, extending the entire length of the building.

On the opposite side of Sanford street is a building two stories in height, 100 x 200 ft., extending through to Nostrand Avenue. In this building are all of the wood-working departments excepting the pattern shops. Power is furnished for the different departments by one 75 H. P. Buckeye engine which is located in the Sanford Street end of the building. The remainder of the ground floor is occupied by the mill and erecting shop.

The mill, which is shown in Fig. 5, measures about 100 x 50 ft., and is equipped with an almost endless variety of wood working machinery of the most improved patterns. Next comes the erecting shop, occupying 200 x 50 ft., a small part of which is shown in Fig. 6. Numerous tracks and one large elevator are provided for quickly and conveniently moving car bodies to any part of the building. The company are at present building some very handsome large open cars for the Brooklyn City Railroad Co., to be used on their Fort Hamilton line.

On the second floor are the cabinet and paint shops,

FIG. 3.—STOVE DEPARTMENT.

FIG. 4.—BLACKSMITH SHOP.

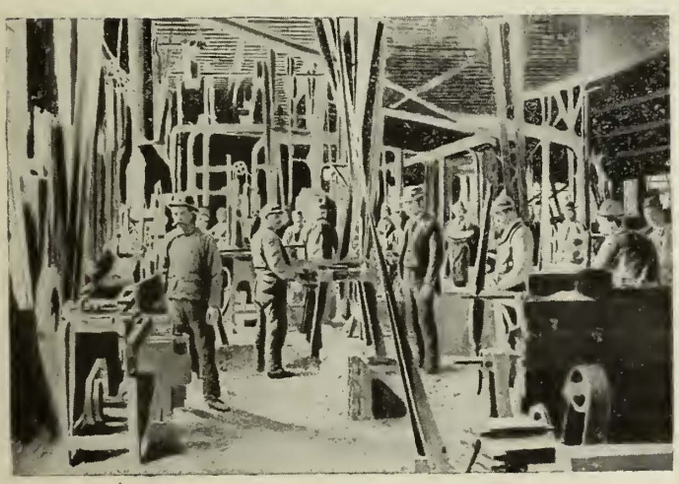


FIG. 5.—MILL.

FIG. 6.—ERECTING SHOP.

FIG. 7.—CABINET SHOP—SASHES AND DOORS.

FIG. 8.—CABINET SHOP—WOOD CARVING.

FIG. 9.—CABINET SHOP—FARE BOXES.

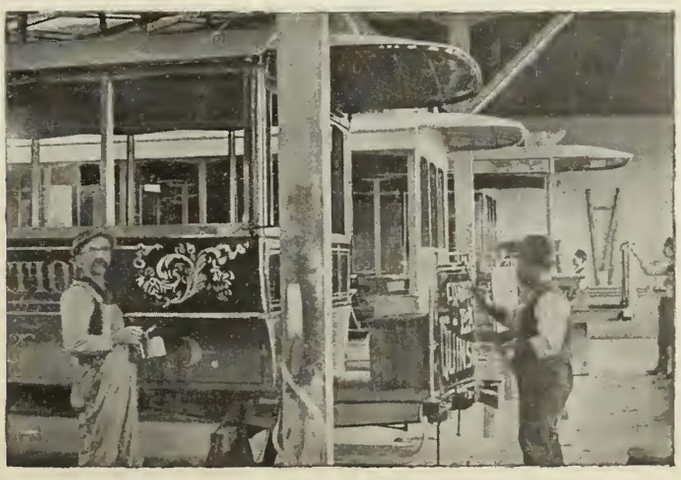


FIG. 10.—PAINT SHOP.

the varnishing room and the upholstery department. The cabinet shop, which is shown in Figs. 7, 8 and 9, is 100 x 100 ft. In this department the very important subject of light was carefully considered. As shown in the illustrations large windows are provided on three sides of the room. In addition to these are large skylights extending the total length of the building. In this department the wooden frames of fare boxes are made and all the delicate joinery work required in the making of sashes, doors and the handsome interior paneling is performed.

FIG. 11.—VARNISHING ROOM.

In the Nostrand Avenue end of the building are located the paint shops and varnish rooms. The paint shop is partly shown in Fig 10. The cut, however, gives a very imperfect idea of the size of the department, which is 75 x 100 ft., with ample room for twenty-five cars. The room is very well lighted and is equipped with all the necessary appliances for quickly shifting the cars to any desired position. In one part of the shop is a large cabinet completely filled with elegant designs for interior and exterior decoration. Partitioned off from this main shop is a room used for mixing colors. Here all the delicate tints used in decorating the cars are prepared.

Adjoining the paint shop is the varnish room, Fig. 11, occupying 25 x 75 ft. In this department the sashes, doors, fare boxes and the hand painted panels which are used for interior decoration receive their final finish.

Mention has now been made of all of the different departments in the main building. In addition, there are two buildings on Sanford Street, 25 x 100 ft., and 50 x 200 ft., used for storehouse and lumber shed purposes, and the pattern shop 50 x 50 ft., which is situated on Walworth Street, opposite the main office building.

The employes of the company number about 350 and the officers are John W. Fowler, president. Daniel F. Lewis, treasurer, and A. H. Dollard, secretary.

The Baltimore Belt Line.

The Belt Line tunnel, which has recently been constructed under the city of Baltimore to provide better terminal facilities in that city for the Baltimore & Ohio Railroad, is 6,000 ft. long. The idea of operating trains through this tunnel by electric locomotives, to obviate the unpleasantness of burning coal in the tunnel, was presented to the Baltimore & Ohio Railroad Co., the lessees of the tunnel, with the result that they have recently closed with the Thomson-Houston Electric Co. for three eighty ton electric locomotives for this purpose. It is believed that these locomotives will have power enough to push a 1,200 ton freight train, including the locomotive, through the tunnel from the south end up a grade of one per cent. at the rate of fifteen miles per hour, and a 500 ton passenger train, including locomotive, through the tunnel at the rate of thirty miles per hour. The locomotives will, of course, be operated from a central station, but the devices and line service will necessarily have to be of special construction.

A Die Slotter.

The die slotter shown in Fig. 1 is claimed to combine in an eminent degree the special features desired in a tool of this kind. The two cross motions and the rotary table provide for following any outline, and the arrangement of handles is convenient and avoids mistaking one for the other. The handle for the rotary table has provision for using dials for dividing purposes, which is convenient for such work as that shown in Fig. 4. For small numbers of divisions and for rapid work the worm shaft can be pulled right out, and a lock pin arrangement used for indexing the table, the handle for which is shown at the left hand side. The handle for raising and lowering the knee is conveniently placed on the side of the knee (not shown in the cut). The stroke of the machine, after due consideration, has been fixed at two and a half inches, which is more than sufficient for the class of work intended, and affords a more solid arrangement than the usual adjustable pin.

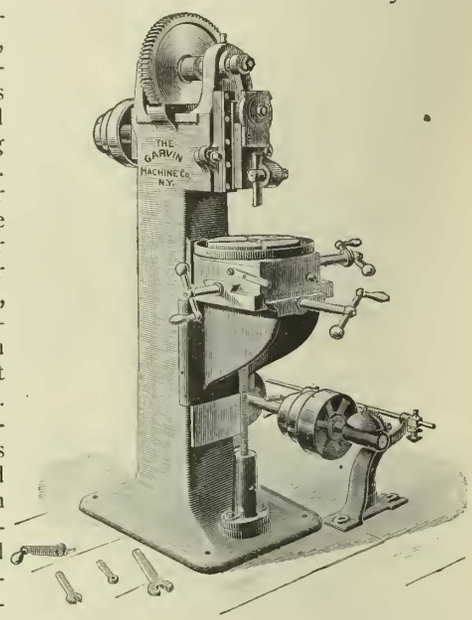


FIG. 1.

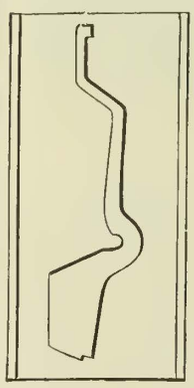


FIG. 2

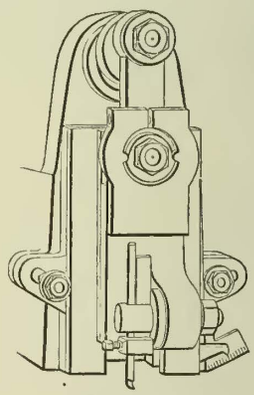


FIG. 3.

The tool block is well adapted to hold special tools, such as the one shown in Fig. 1, made of Stubb's steel, clamped in a holder. The tool is cleared on the return stroke by an ingenious arrangement, shown more clearly in Fig. 3. The tool block swivels on a centre near the lower edge; and at the upper end, carried in a yoke, are two hardened plugs which bear on a cam, which is bushed in to the lower end of the connecting rod, and derives a partial rotary movement from the action of the rod, and by this motion locks the tool block. As an instance of what can be done on the machine, a typewriter key of form shown in Fig. 2, ten inches long and three-sixteenths of an inch wide at the narrowest part, was machine finished in six hours. A die for armature rings, five inches in diameter, with thirty-six notches, one-eighth of an inch wide. a quarter of an inch deep, such as shown in Fig. 4, was done in two hours. The makers are the Garvin Machine Co., New York.

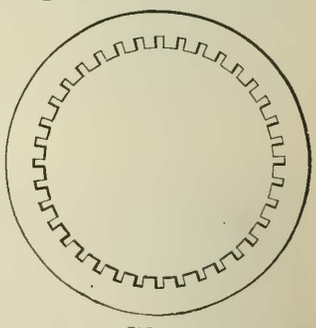


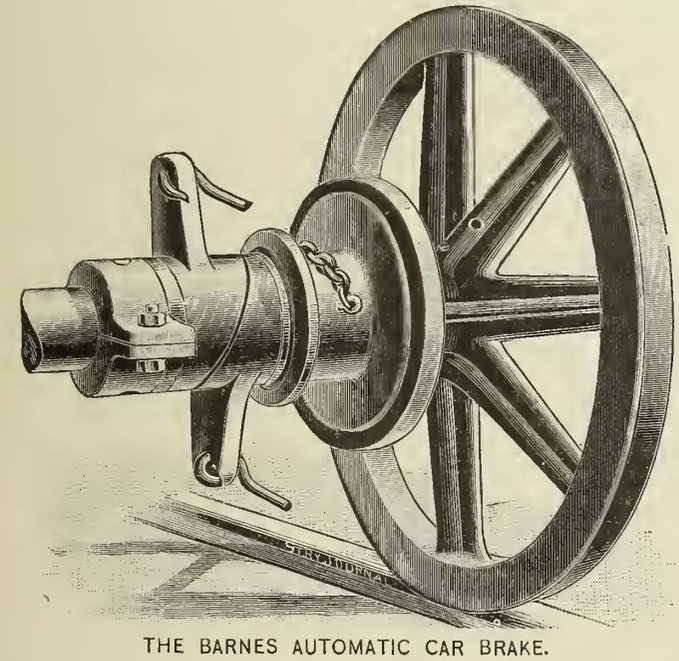
FIG. 4.

J. S. HOLLENBECK, of Chicago, and others, have received a franchise for an electric railway in South Austin, Tex.

The Barnes Automatic Car Brake.

Reference was made in our last issue to a new car brake which has been installed on the cars of the Brooklyn (N. Y.) Heights Cable Railway Co. These cars operate on a 9½ per cent. grade, so that the conditions to which a brake on this line is subjected are most severe. Nevertheless cars have been stopped by it in a length of eight feet while descending the grade at a speed of eight miles per hour. The brake is equally adapted to cable and electric roads.

On one axle are two friction plates separated from each other by a leather washer, one plate being keyed to the axle, the other mounted loosely upon it and carrying a drum for winding up a chain which sets the brake shoes. Also mounted on the axle is a collar attached rigidly to the axle, and between this and the drum is a pair of cams, or circular wedges, loose on the axle, and separated from both collar and drum by split brass rings. Each cam is provided with a short lever to which are run two rods, operated by the platform lever or brake handle, so that the cams can be spread by a movement of the latter. The operation of the brake is then easily understood. The spreading of the cams forces the drum plate against the leather washer and friction disc keyed to the shaft, and



THE BARNES AUTOMATIC CAR BRAKE.

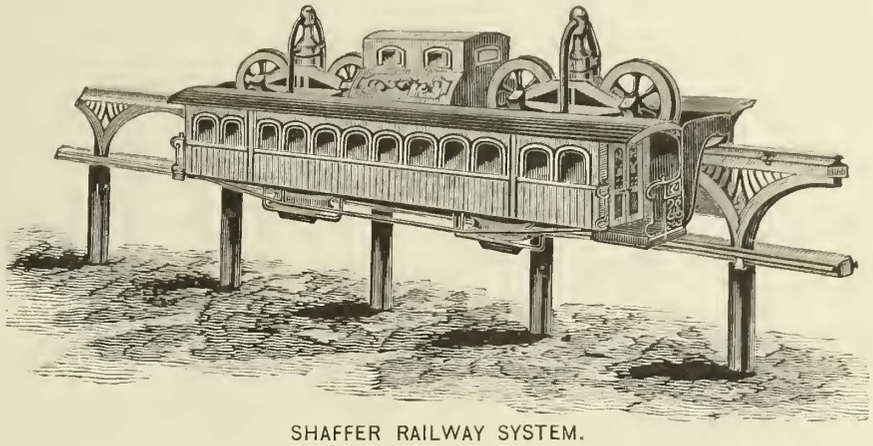
the wheel being in motion takes the drum around with it and winds the chain, pulling the brake levers and setting the brakes.

To reduce the friction between the drum and axle when the brake is not in use, brass bushings are used with felt linings in the centre. These linings are kept saturated with oil, and this arrangement has been found to work very successfully. The entire weight of the attachment is less than 200 lbs., it can be adapted to electric cars so as to take up a space of less than eight inches on the axle, and its parts are so simple that they can be readily understood and cared for by an ordinary mechanic. The only part to wear is the leather washer, and this it is claimed by the manufacturers of the brake, The Barnes Brake Co., of Cleveland, O., will last at least six months and can then be replaced at a small cost. By a very simple arrangement the driver or motorman of the first car of a train can operate the brakes on one or two trailers equipped with this device.

AN incline cable railway is proposed between Meadowville, N. Y., and a summer resort on the Heilderberg Mountains.

An Elevated Railway System.

The Shaffer single column railway system, illustrated in the accompanying engraving, was designed with the idea of constructing an elevated structure which would occupy but little ground space. The posts, or supporting pillars, are connected near the top by a substantial framework surmounted by a top plate which sustains the single rail. On each side of the posts is located a girder rail, the bearing surface of which is at right angles to the face of the top rail.



SHAFFER RAILWAY SYSTEM.

As will be seen by the illustration, the car is in two main compartments, suspended on either side of the upper rail. These two main compartments are connected by a cupola which forms a third small compartment.

For passengers the car has one row of double seats next the windows, and the aisle or passage way is next to the inner wall. This aisle, in each main compartment, is connected with the cupola by a short stairway on either side, thus giving free access to all parts of the car.

The weight of the car is carried by two trucks, of two wheels each, as shown in the illustration. These main carrying wheels are double flanged, the space between the flanges being a trifle wider than the face of the rail, to allow for rounding curves. These trucks are provided with regular journal boxes, oil cups and springs.

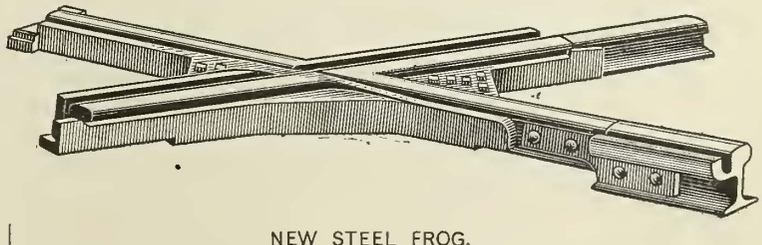
The trucks are surmounted with a pivoted turret which allows all side motion necessary in rounding any ordinary curve, and over and through these turrets heavy wrought steel arms are suspended, and to these arms the car is firmly attached and suspended.

Underneath the car, on each side, are two guide wheels, which stand at a right angle with the upper wheel and run upon the two lower or guide rails, to steady the side motion of the car. These guide wheels press firmly upon their respective rails, but are provided with short, strong springs in their boxes, so as to allow them to yield slightly in rounding the curves.

The inventor of the system, William T. Shaffer, of Evanston, Wyo., states that while steam may be applied as motive power, he regards electricity as best adapted to the purpose.

New Steel Frog.

The accompanying illustration shows a new steel frog made for regular diamond or side turnouts as well as for special locations, manufactured by Barbour, Stockwell & Co., of Cambridgeport, Mass.



NEW STEEL FROG.

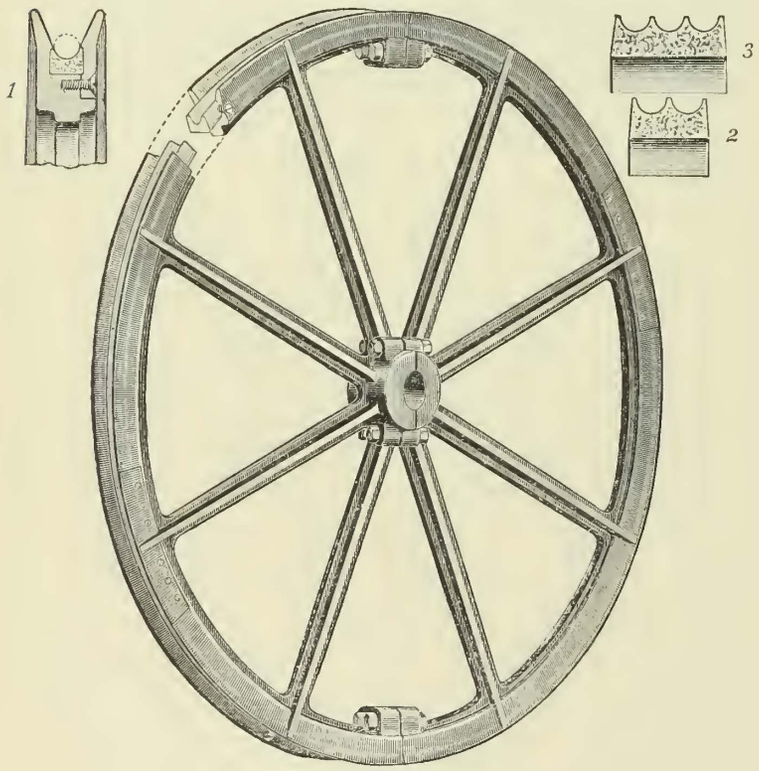
The frog is made from any section of girder, T or tram rail and cast into a bed plate of gun metal, as shown in

cut. The rails are punched at short intervals and the gun metal flows through from side to side, uniting the two metals, and holding the rails rigidly in place. The ends of the rail project to receive the fish plates, which connect the frog with the track, giving a continuous steel rail to receive the wear of the wheels, and having no bolts to work loose.

A New Cable Sheave.

In the accompanying engraving is shown a new cable sheave which has recently been brought out by Wm. F. Buswell, of San Francisco. The object of the invention is mainly to avoid wear on the main parts of the sheaves by making the parts subject to wear changeable, and also to obviate that wear on the cables which occurs when they bear on soft iron which retains sand or grit. The inventor informs us that with carefully made patterns the hard segments made of chilled cast iron, steel, or other similar material can be inserted in a very complete manner in the rim of a sheave and that when filled and closed by the side plates are safe from accident.

In the engraving 1 is a section of the rim for a single rope, 2 and 3 show sections of the inserted sections for a number of ropes or wraps, the construction of the sheave



A NEW CABLE SHEAVE.

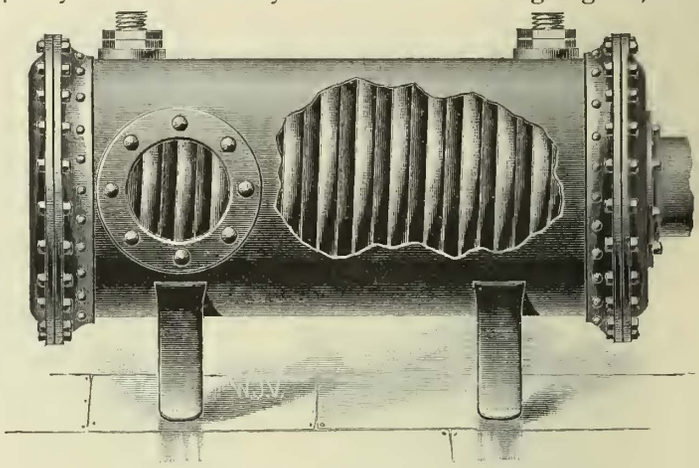
being, otherwise, the same as for a single rope. These hard sections can be removed or replaced while the wheel is in position and without removing the ropes, by taking off the side plates which are a little longer than the inserted sections.

An interesting test of the relative resistance of a new trolley wire joint and the same length of straight wire was recently made in Boston. The wire in both cases was copper, eight inches long and No. 0000 B. & S. The joint was made in the usual way with three or four turns at each end, about two and a half inches between, and the whole thoroughly soldered. The test showed about 10 per cent. less resistance in the jointed than in the straight wire.

A lady on entering an electric car observed that an iron bolt projected slightly above the floor, and remarked to the conductor: "I suppose if I were to put my foot on that bolt I would receive a shock." To which that official scientifically replied: "Not unless you put the other foot on the trolley wire; fare, please."

A Horizontal Feed Water Heater.

A horizontal feed water heater, which can be successfully and economically used with condensing engines, and

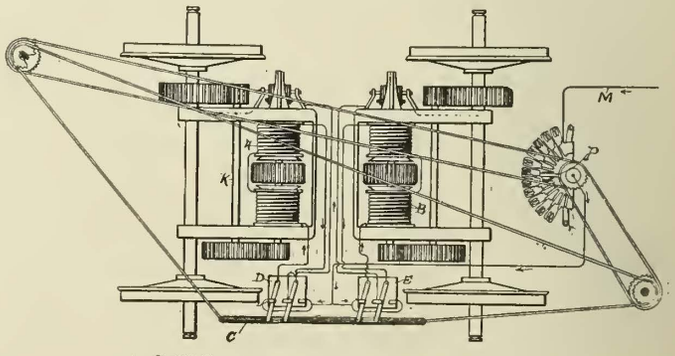


A HORIZONTAL FEED WATER HEATER.

is already in use in a large number of such plants, has been recently brought out by the National Pipe Bending Co., of New Haven, Conn., manufacturers of the National feed water heater. The exhaust can be arranged to enter at the ends of the heater, or through the side as may be desired, and this point is quite valuable in places where there is but little room for a heater. In many electric stations the heater is placed under the engine room floor and hung from the floor joists, and the ease with which the National heater can be placed in small spaces between engine and condenser makes it much sought after and used. We present a view of the appliance.

A Device for Braking Electric Cars.

A method of stopping or braking electric cars, by means of connecting the motors in a local circuit and causing one motor to act as a generator, has recently been patented by Prof. Sidney H. Short, of Cleveland, O. As will be seen from the accompanying engraving, which gives a diagram of the connections used by Professor Short, the motors are provided with a circuit breaker and a double reversing switch, or a pair of double connected reversing switches, so arranged that the supply circuit is shut off when the reversing switches are operated. The switch levers are mechanically connected by the insulator arm, C, so that they can be moved together. In the engraving the connections are as they would be when the car is in operation and the motors are drawing their supply from the main circuit through the wire, M, and the switching arm of the rheostat is upon a middle block. The current then passes through the rheostat in the direction of the arrows, separating just before it comes to the reversing switches which are indicated by D and E. The part of the current which passes to the right first goes



A DEVICE FOR BRAKING ELECTRIC CARS.

through the field magnets of the motor, B, then returning to the reversing switch passes through the armature to the car axle where it is grounded. As the motors are connected in parallel, the current through motor, A, takes a similar course. The switching arm, P, of the rheostat

can be operated from either end of the car by means of gear wheels and sprocket chains as shown.

To stop the car, the motorman turns his regulator handle until the arm, P, has traveled over all the contacts and finally breaks the main supply circuit. Without shifting his position the motorman also reverses the contacts of the motors by means of a movement of the arm, C. Then, by tracing out the connections, it will be seen that the motors are in a local circuit. In this local circuit, when it is first formed, the two motors now being revolved by the momentum of the car generate opposing electro-motive forces, depending in amount upon the residual magnetism in the field magnets of each. One of these electro-motive forces, being naturally the stronger, owing to the usual, if not inevitable, difference of residual magnetism in the two machines, even when the motors are made like each other, as customary, prevails over the other and establishes its current in the local circuit. Assuming that the machine, B, becomes the stronger generator, the current will flow in the local circuit through the field magnets of B in the same direction as before, owing to the change in terminal connections, increasing B's field magnetism and consequently its electro-motive force, at the same time decreasing the field magnetism, and consequently the counter electro-motive force of the motor, A. As this counter electro-motive force decreases, the current from B rapidly augments and reverses the polarity of the field of the motor, A. As soon as the polarity of the field motor, A, is reversed the current from generator, B, tends to revolve the armature of motor, A, backwards and stop the car. Thus the car is stopped by the resistance caused by motor, B, acting as a generator in conjunction with the reversal of the motor, A, under the influence of the current from the generator. As the movement of the car ceases, the current from generator, B, ceases also, and if the car is on a down grade it will creep slowly down the grade.

If the machine, A, acting as a generator, should be of greater electro-motive force than the machine, B, the effect will be the same.

In order to propel the car in the opposite direction the current can be admitted again through the rheostat while the switches are reversed.

Railway Power House at Grand Rapids.

The system of the Consolidated Street Railway Co., of Grand Rapids, Mich., is one of special interest to street railway men, and it has attracted no little attention, for the reason that the present management on assuming control discarded the cable and substituted electric motors. The company believed thoroughly in electric power, and last month the single road operated by horses became an electric line. The city of 80,000 residents is admirably supplied with transit facilities by the fifty-two miles of lines within the corporation limits.

It should, perhaps, be stated by way of preface that the cable was abandoned by the management not because they were prejudiced against it as a means of propelling street cars; but because they considered it ill-adapted to the conditions existing in Grand Rapids. It did not pay, for example, to maintain by cable a ten minute service on a line on which seven cars were operated; the expenditure of power was too great. Since the introduction of electricity on the lines formerly operated by cable the cost of operation has been greatly reduced; just how great the reduction has been the management is not willing to state. It may be remarked, however, that one pair of engines formerly used for cable service is now able to carry the ordinary load on the entire power station.

Sixty-one Edison motor cars, seven of which are of fifty H. P. and ten motors of thirty H. P., made by the Detroit Electrical Works, are operated by the company.

The motors are giving entire satisfaction in spite of the fact that they are subjected to severe service. There is one grade of 9.1 per cent. covering a distance of 1,200 ft., and on a second line a grade of 8 per cent. is encountered. The lines on which these grades are found were formerly operated by the cable, and as two brakes are necessary as a matter of precaution the company have adopted a slot brake. This consists of a heavy chilled steel shoe which is forced into the slot by wheels located on both the front and rear platforms, so that it can be applied by both the motorman and conductor. So effective is the brake that the car can be fairly lifted by means of it from the track.

The company believes in laying good track. Johnson girder rails, weighing sixty-six and one-half pounds, and seventy-eight pounds are used. The latter are spiked directly to the ties.

The power station of the company, located near the centre of the system, is a very complete plant and it contains features of unusual interest. Steam is generated in boilers of an aggregate capacity of 1,550 H. P., as follows: 4 Babcock & Wilcox, each of 200 H. P., one marine, constructed by the Lansing Iron Works, of 300 H. P., and 3 double-decked, internally fired boilers built by the Lansing Iron Works, of 150 H. P. each.

The engines are arranged in two pairs. The first pair is Hamilton Corliss, 24 x 60, making 60 revolutions. The aggregate weight of the flywheels and driving wheels is 80 tons, which is sufficient to balance any variations in the load. This pair of engines is rated at 800 H. P. but is capable of developing 1,000 H. P. The engines have independent condensers.

The other pair of engines was made by the Wheelock Engine Co., of Worcester, Mass. They are 24 x 48, making 80 revolutions, and are rated at 800 H. P. At present they are operated non-condensing.

The transmission from engine to countershaft is effected by rope transmission, and here is found a particularly interesting feature of the plant. The Wheelock engines were formerly used for cable work in a different power station, but were removed to the present location when the change in power was decided upon. When power was transmitted to the cable there were two sheaves employed, one 5 ft. in diameter with 5 ft. face attached to the engine shaft and the other 15 ft. in diameter with 5 ft. face. Both sheaves are cut with twenty grooves, each designed for a two inch independent rope.

When it became necessary to drive generators, and use the same sheaves, it was necessary, in order to secure the desired speed, to reverse their position, putting the fifteen foot pulley on the engine shaft. A difficulty was at once encountered, resulting from the fluctuating character of the load. One or two ropes would tend to carry all the load while the others were doing comparatively little. To hold the ropes down to this work, therefore, it was found necessary to use an idler, by the introduction of which almost all difficulty has been removed. When a new rope is put on, no matter how tightly under the idler, it will stretch a foot in a few hours, and it is found that there is ultimately a stretch of four feet in the entire loop. The rope cannot be cut and respliced at the same point, for at the juncture there is so much chafing that the ends cannot be spliced. The rope cannot be cut in a new place and joined, for while there is four feet of stretch it requires twelve feet for the splice. This difficulty has been so pronounced that the management has decided to try the American system of rope drive, in which a continuous rope is employed on the pair of Hamilton-Corliss engines. The pinion for transmitting the power in this case is five feet in diameter, and the ropes lead over a sheave twenty feet in diameter, each having twenty-two rope grooves. The single ropes previously used will be utilized for filling the places of those on the other pair of sheaves, as they wear out. As the American and English systems of rope drive, of which both have their enthusiastic advocates, will be in use in the station, those interested will have an excellent opportunity to compare their relative merits.

The countershaft, which was installed by the Hill Clutch Works, of Cleveland, O., affords a most flexible means of transmitting and distributing power. The shaft is not continuous, but is divided in sections. Each outer end of the shaft drives two generators, and these sections of the shaft can be cut off. The five foot sheaves, already

referred to, are not attached directly to the shaft, but are fastened to quills which have their own bearings. The quills lying concentric with the main shaft are attached to it by heavy friction clutch couplings. A third quill is used to drive a third pair of generators, permitting the operator to run a part of the machinery, while the shaft is not encumbered with the weight of friction clutches. One of the generators is driven from a clutch pulley. This arrangement affords a flexibility in operation which is found to be highly convenient and economical.

The generators are seven in number and are all Edison, No. 60 machines of 175 K. W. capacity, each. A generator of the Detroit Electrical Works type has recently been installed, which is driven by an automatic cut-off engine. This machine is operated to supply the electric light system and to furnish current for "owl" cars.

The current from the generators is carried to the switchboard where the total output is measured on a meter of 2,000 amperes capacity. The current is then carried to a second board where it is distributed among the several lines.

In examining the power station a visitor will be struck particularly by the sprinkler system arranged as a precaution against fire. Not only has the system been applied to the interior of the building, but the rear of the structure is protected in the same way. No buildings adjoin the station at the sides, but several factories are located at the back, separated by a narrow alley. The sprinkler system has been so applied that this passageway can be thoroughly drenched in case of fire in the vicinity. As a result of these precautionary measures the company is able to secure insurance rates that are entirely satisfactory.

THE Jamestown (N. Y.) Street Railway Co. are adding considerably to their power plant as well as to the equipment of their line. This plant was illustrated in our August, 1891 issue, and the new cars for additional equipment, which were furnished by the J. G. Brill Co. in our April, 1892, issue. These new cars have been received at Jamestown and are now equipped for service. This road is one of the best illustrations to which we can point of the difficulties that can be overcome by the electric motor. It is one of the most successful of all the smaller roads. The motors in use are the "Standard" motor, manufactured by the Short Electric Railway Co. of Cleveland, O., and are spoken of in the highest terms by the management of the road. A. N. Broadhead is president, and George E. Maltby manager.

Correspondence.

Communications on all subjects of interest to street railway managers are solicited. Names of correspondents may be withheld from publication if desired, but must be known to the editors. The correspondent alone is responsible for his statements and opinions, not the editors.

Rochester Boiler Test.

ROCHESTER, May 24, 1892.

EDITORS STREET RAILWAY JOURNAL:—

On April 2 last, I was requested as head fireman of the Rochester power house, with the assistance of Mr. McNamara, to make a test of the Heine Safety Boiler Co.'s boiler. A statement has been made in the STREET RAILWAY JOURNAL and other papers by the Heine people that the firemen were unable to get a good start, got excited, etc. I desire to brand that statement as a deliberate falsehood, and state that everything that possibly could be done under the circumstances was done to fully demonstrate the capabilities of the Heine boiler, and I am willing now to challenge any firemen that work for the Heine company to run one boiler of the Babcock & Wilcox company for a ten hours' run, against two boilers manufactured by the Heine people.

Trusting that you will give this letter the publication which it deserves, I remain,

Yours respectfully, WILLIAM E. ROOTH,
Head Fireman Rochester Railway Co.

Minneapolis Power Station.

Work has been pushed forward during the last few months on the new electric power station of the Minneapolis Street Railway Co. at Thirty-first Street junction and contractors, DeLancey & Cook, have finally finished their work. The original design was to install five engines and five generators, but with the increased demand for street car facilities, it was decided to double the capacity of the power house. This required a remodeling of the original plans. The plant will furnish power to the portion of the street car system which is located south of Washington Avenue and between Minnehaha Falls and Lakes Calhoun and Harriet.

The area of the engine room is 87 × 70 ft. The engines are of the Westinghouse compound type with a high pressure cylinder sixteen inches in diameter, and low pressure cylinder twenty-seven inches in diameter by sixteen inch stroke, and are designed to generate from 250 to 300 H. P. Each is connected to a generator by a twenty-four inch leather belt running around an eighty-two inch pulley on the engine and a thirty-six inch pulley on the generator.

The generators are of the 275 K. W., multipolar type, manufactured by the Thomson-Houston Electric Co. The boiler room is nearly as large as the engine room and contains seven Stirling boilers of 287 H. P. each. These rest upon a solid wall which extends eight feet below the floor, and the whole will be enclosed by brick walls when finished.

The fuel to be used is crude oil which will be pumped in from two tanks as it is needed. The floor of the boiler house will be concrete and supported by arches. The stack is 165 ft. high. The water supply for the plant will be furnished by an artesian well which will be over 1,000 ft. deep.

The General Electric Co.

This is the title, already familiar to our readers, which has been adopted for the company formed by the consolidation of the Edison General Electric Co. and the Thomson-Houston Electric Co. Articles of incorporation for the company have been taken out at Albany, N. Y., and the capital stock authorized is $50,000,000.

The following directors were elected May 4: H. McK. Twombly, chairman; F. L. Ames, C. A. Coffin, T. J. Coolidge, C. H. Coster, T. A. Edison, E. Griffin, F. S. Hastings, H. L. Higginson, D. O. Mills, J. Pierrepont Morgan. Officers of the company were then chosen as follows: President, C. A. Coffin; vice president, E. Griffin; second vice-president, S. Insull; third vice-president, not filled; treasurer, A. S. Bevis; first assistant treasurer, B. F. Peach, Jr.; second assistant treasurer, W. F. Pope; secretary, E. I. Garfield; assistant secretary, A. S. Bevis; comptroller, J. P. Ord; auditor, E. Clarke.

As will be seen, both the Edison and Thomson-Houston interests are represented, the president, first vice-president, first assistant treasurer, second assistant treasurer, and secretary having been connected with the Boston company, and the second vice-president, treasurer, assistant secretary, auditor and comptroller from the Edison company.

Street Railway Affairs in Milan, Italy.

Milan, Italy, has a population of 420,000 souls and is, next to Naples, the largest city in the peninsula. The actual paid up capital of the Anonymous (or limited) Tramways Co, of which we gave some facts in our last issue, and who own all the street cars and most of the omnibuses in the city, is 1,500,000 lire, or about $300,000, and the amount paid in dividends last year amounted to 500,000 lire.

Street railways were introduced into Milan in 1876, by the same company which then had the monopoly of the omnibus traffic. The average term of service in and about Milan of the Italian street car horse is four years; that is, this is the average period elapsing between the time that a horse is purchased and the time when it is sold. The company, however, have one horse, still in active service, which was bought and first put to work in 1863. There are still three which have been on the road since 1875 (seventeen years' service), six since 1876, six since 1877, twenty-seven since 1878, thirty-four since 1879 and

forty-eight since 1880. This will show how well the stock is taken care of, or they would not otherwise have lasted so long.

The Milan Street Railway Co. are proprietors of the fields where each horse takes its yearly hard earned holiday. This land is situated at about four kilometres from the centre of the city, at a suburb called Castagnedo.

Of the 220 street cars, half a score of the closed cars have roof seats; these vehicles were all made abroad and bought by the company. 176 of the closed cars have no roof seats, the upper story not being popular in the Latin countries outside Paris. Of these, 152 were made in the company's own workshops, and twenty-four were purchased from foreign firms. The 'gardener' or completely open cars number fourteen, of which half were made by the company's employes, and half were procured from abroad. During the past few years, no less than 230 cars and vehicles have been broken up and sold, but not one thus treated was among those manufactured in America or Britain, the doomed ones being all of native make.

The company have 1,000 employes of all kinds, the highest number being coachmen, who number 276. There are 237 stable hands and 223 conductors. The company have recently established a pension fund, finding that the number of deaths every year among their staff (about a dozen) caused demands to be made on their charity. Every employe pays twenty centimes or four cents per week to the fund, and in the event of his illness he receives $1.40 weekly from the fund, or in case of death his widow or other dependent relative is entitled to fifty cents weekly for a certain stipulated time.

The Melbourne Tramway System.

The following interesting statements relating to the street railway lines of Melbourne, Aust., are quoted from the *Argus* of that city under date of January 21, 1892. The different amounts have been changed from English to American money, one pound being estimated at $4.86 of our money.

The balance sheet of the Melbourne Tramways Trust for the half-year ending December 31, 1891, has been issued with customary promptness by Mr. Hugh T. Jordan, treasurer to the trust. The principal work of construction carried out during the six months was the completion of the last line of cable tramway embraced within the scheme, namely, the branch line to the St. Kilda Esplanade. The expenditure upon this line during the half-year amounted to $65,571.12, besides a sum of $27,954.72 spent upon the engine house and machinery. The sum of $11,075.94 was also spent in completing the works at Prince's Bridge, rendered necessary by the subsidence of the embankment of the new roadway. The total disbursements for the half-year amounted to $137,980.26, of which $3,771.36 was spent in administration, $8,184.24 in the engineer's department, and $123,283.62 in general works. Some alterations remain to be carried out at Market Street and elsewhere, and the construction of the tramways, which has extended over a period of about eight years, will then be complete. The cost of these works will be trifling, so that some figures may now be given respecting the cost of the scheme as a whole.

The total expenditure of the trust up to December 31, 1891, amounted to $8,082,529.92. *The money was borrowed* at various times *at 4½ per cent. interest*, and the following table shows the amount of each loan and the premium obtained upon it:—

Year.	Loan.	*Premium.*
1884	$2,430,000.00	
1885	2 430,000.00	$ 42,525.00
1887	972,000.00	50,635.84
1888	1,215,000.00	105,387.80
1889	243,000.00	20,146.74
1891	631,800.00	46,364.82
Totals . . .	$7,921,800.00	$266,372.20

The gross amount realized from these loans was therefore $8,188,172.00, the actual cost of which to the trust is reduced to about 4¼ per cent. The aggregate borrowing power of the trust is $8,011,000.00, so that it is in a position at any time to obtain $89,200.00 if further funds should be requisite. On December 31, however, the trust had a credit balance at the bank of $123,045.48.

The *total length of cable lines* completed (double track) is forty-three miles fifty-three chains, and of *horse lines*, three miles six furlongs. The cost of constructing the cable lines has averaged $179,820.00 per mile. The original estimate was something under $155,520.00 per mile, but the excess has been caused in a large degree by circumstances quite apart from the actual construction of the lines. In the first place the haulage power provided is greater than was originally contemplated. The results of the first year's work on the Richmond line, which was the first to be opened, indicated that the traffic on the system as a whole would be heavier than had been anticipated in framing the estimates, and the power of the machinery had to be increased accordingly. As the lines now stand, power is available for nearly treble the present traffic. Again, the prices paid for sites for engine-houses were in some cases much beyond the estimates, for as the choice of the trust was restricted in each case to a very small radius, and prominent corner allotments were in nearly every instance required, the trust had often to pay very stiff figures for the land. At the present time, therefore, the trust owns a number of valuable sites, for which it has paid a total of $372,621.06. The cost of the drainage works necessitated by the cable tunnels was another disturbing element, the expenditure under this head alone having amounted to the sum of $316,386.00. Alterations to gas pipes intersecting the tram lines involved an outlay of $133,164.00, and $89,424.00 was spent in altering water pipes. The widening of the Kew and Hawthorn bridges, another unforseen contingency, cost in the one case $50,544.00, and in the other $34,992.00. Among other items of expenditure the purchase of redgum blocks for paving cost no less than $613,545.84, of which the saw millers of Gippsland reaped the benefit. Cement was bought at a total cost of $487,647.54, and $31,347.00 was paid for the use of patents.

The work of constructing the tramways has been carried out, as is well known, under the supervision of a trust elected by the municipalities upon whose security the money has been borrowed, and it is interesting to to notice the cost of engineering and administration during the eight years over which the undertaking has extended. The total expenditure in the engineer's department up to the end of the year amounted to $144,614.16, which is equivalent to a small fraction *over 1¾ per cent. upon* the total outlay. The cost of the administrative department during the same period was $41,577.30, or a little over ½ per cent. Engineering and administration together have therefore amounted to about 2½ per cent. upon the total expenditure, a result which indicates that there has been no extravagance in the operations of the trust. The presiding genus in the entire work has been, of course, *Mr. C. S. Duncan, the engineer-in-chief*, and the excellence of his handiwork is proclaimed by the tramways which as a piece of engineering alone are the admiration of all who see them.

The *Melbourne Tramway Co.*, which works the line, undertakes to pay the interest on the total cost, amounting at 4½ per cent. to $356,481.00. In addition to this, it *undertakes to provide a sinking fund* which *will pay off the entire cost of the scheme by the expiration of the company's lease* of thirty years. The Tramways Act provides that during the first ten years the company, in addition to paying the interest as it falls due, shall pay 1 1-2 per cent. per annum upon the total amount borrowed; during the second ten years 2 per cent. per annum, and during the third ten years 3 per cent. The first contribution to the fund was made on July 1, 1885, so that the increase to 2 per cent. will commence in 1895, and the increase to 3 per cent. in 1905, the lease terminating in 1915. The contributions to the sinking fund up to December 31, 1891, amounted to $764,721.00, and the annual payment required from the company during the next three years is $118,827.00. At the present time, therefore, the *payments out of profits which* the company make to the trust for interest and sinking fund amount to a total of $475,308.00 a year. After July, 1895, and until July, 1905, the total will be $514,917.00 a year, and from 1905 till the termination of the lease the sum due annually to the trust will be $594,135.00. It is calculated that by this means when the lines revert to the municipalities in July, 1915, they will be perfectly free from debt. *The rolling stock, car sheds (but not the engine-houses), factories, and repairing shops, with the land appertaining, belong to the company.* The sinking fund is invested in 5 per cent. municipal debentures, but to prevent any difficulty arising from the scarcity of such securities, power was given to the trust by the last amending act to lend money on first mortgages, if deemed desirable. The administrative charges up to the end of the current year will continue to be defrayed out of loan moneys. After that time they will be borne jointly by the municipalities and the Tramway Co., but the contribution of the latter is limited to $4,860.00 a year.

The following is a statement of the assets of the trust as on December 31, 1891:

By public works department		$25.53
By Melbourne and Metropolitan Board Works		1,098.24
By South Melbourne City Council		717.08
Total		$1,840.85
By bank balances (including London accounts)—		
Commmercial bank	$62,969.00	
City of Melbourne bank	60,076.96	
		$123,045.96
Total		$124,886.71
By petty cash in treasurer's hands		$204.50
By contractor's deposits		3,529.57
Total		$128,620.78

Street Railway News.

General.

Bridgewater, Mass.—Each employe of the electric road has been presented by General Manager Rogers with a $1,000 life insurance policy in the Mutual Life of New York, the first payment of which is paid.

Brooklyn, N. Y.—The Brooklyn, Bushwick & Queens County Railroad was to have been sold under a judgment of foreclosure, April 29, but the sale was postponed until May 26.

CARS were run on the Third Avenue line on Friday, May 20. President Lewis and a party composed of officials of the road and other gentlemen made a trip from Twenty-fifth Street to Fort Hamilton where lunch was served, and thence to the power station. On May 23 the dummies were taken off and twenty-eight electric cars were placed in service.

Chester, Pa.—The contract for rails for the new electric railway here has been awarded to the Lewis & Fowler company. About five miles of box rail will be laid.

Chicago, Ill.—The West & South Towns Street Railway Co. have not yet commenced construction on their electric road. This company have a franchise to use almost any power except steam, with

the proviso that if electric power be used the feed wires will be placed underground. The company will probably combine a light freight business with their passenger business.

THE property of the insolvent Belding & Manufacturing Co. whose factory was at Hermosa, Ill., has been sold by auction to T. J. Indermille for $71,800. His purchase is subject to a $40,000 mortgage.

THE ordinance of the Arcade Rapid Transit Co. for an underground railway on West Monroe Street has been favorably recommended.

THE Chicago City Railway Co. last month paid their quarterly license fee to the city treasurer, amounting to $4,403.75. The fee paid by the North Chicago company was $2,518.75.

THE Jackson & Sharp Co. have delivered twenty-five passenger coaches to the Rapid Transit Co. for use on their south side elevated railroad. This is the first installment of fifty cars contracted for by this company.

A POOL has been formed in Philadelphia, so it is reported, to obtain control of the street railroads in this city.

A SATISFACTORY test of the Kinetic motor illustrated in the April issue of the STREET RAILWAY JOURNAL was recently made on the downtown tracks of the West Chicago company.

THE owners of the Lake Street elevated road have ordered material and propose to begin at once the work of extending the elevated structure of which a mile is now completed.

Cleveland, O.—Another attempt was made last month to consolidate the different street railway companies, but the project was finally abandoned.

THE Westinghouse company have secured the contract for the entire equipment of the Woodlawn Avenue & West Side Street Railway Co.

Concord, N. C.—The Concord Street Railway has been purchased by the Odell Manufacturing Co. The road will at once be re-equipped.

Detroit, Mich.—When the Fort Wayne & Elmwood Street Railway Co. decided lately to procure tenders for a complete electrical outfit, it was decided to reorganize, since the state charter expires in 1895 aud the city franchise in 1900, as it was necessary to have the contemplated issue of bonds for the new equipment extend beyond the date given. Accordingly the name of the company has been changed to the Fort Wayne & Belle Isle Railroad Co., with a new directorate.

THE Board of Public Works, under instructions of the Common Council, has taken up the tracks of the East Detroit & Grosse Pointe Railway Co. on the Cadillac Boulevard. For nearly two years no cars have run over the line, and there has been a strong demand made by property owners in the vicinity to have the tracks removed. The Council has several times notified the company to remove them, but nothing was done. The company claim that under their franchise it is not in the power of the Common Council to set aside their franchise. No doubt the matter will find its way into the courts in a suit for damages against the city.

Dubuque, Ia.—A second application for a receiver for the Dubuque Electric Railway, Light & Power Co. was brought up last month before Judges Shiras and Caldwell of the Federal Court in St. Louis, when Horace Poole was appointed as the receiver. The petitioners were the Thomson-Houston Electric Co., the Edison General Electric Co., Heine Safety Boiler Co. and other creditors.

Dunkirk, N. Y.—The Dunkirk & Fredonia Street Railway Co. has been organized by the Council to remove tracks from the side to the centre of the street on part of their line.

Elizabeth, N. J.—The Twin City Rapid Transit Co., of St. Paul and Minneapolis, with a capital of $20,000,000, held their annual meeting here last month. The following directors were chosen: Thomas Lowry and C. G. Goodrich, of Minneapolis; John Kean, Jr., Elizabeth; J. Kennedy Tod, New York; Charles Fairchild, Boston.

THE United States Steam & Street Railway Advertising Co., Carleton & Kissam proprietors, have recently closed a lease for the advertising privileges in all the cars of the Elizabeth Street Railway Co.

Fishkill, N.Y.—Ground has been broken for the Fishkill Landing & Matteawan Electric Railway. It is to be completed by July 1.

Fonda, N. Y.—Construction has begun on the new Fonda, Johnstown & Gloversville Electric Railway. The road will be completed October 1, 1892.

Fort Edward, N. Y.—The village trustees have directed the Corporation Council to commence action compelling the Glens Falls, Sandy Hill & Fort Edward Electric Railway to extend the road to the postoffice.

Fort Worth, Tex.—The line from the city to the Polytechnic College has been begun and is to be in operation in about thirty days.

Galveston, Tex.—The City Railroad Co. are pushing the work of equipping the Thirty-third Street line with electricity.

Gloversville, N. Y.—The Belt Line road of this city and the Cayadutta Electric road have consolidated and bear the name of the Cayadutta Co. The movement is for the mutual interest of both companies.

Hamilton, Ont.—The street railway company are making great headway in changing the system to electricity.

Haverhill, Mass.—The Haverhill & Groveland Street Railway has been sold to the Industrial Improvement Co. of Boston. The road, which includes fifteen miles of tracks, will be equipped with electricity.

Holyoke, Mass.—C. N. Blakeslee & Sons, of New Haven, have begun the construction of the Holyoke Electric Railway.

Iowa City, Ia.—The Iowa City Electric Street Railway Co. have surrendered to the city all rights granted them by franchise. This will leave the city free to negotiate with other parties, and it is understood steps will be taken immediately toward the securing of an electric system for that city.

Jamestown, N. Y.—The Jamestown Electric Street Railway Co. have built an electric light plant which will be used to illuminate sections of the line. The plant has a capacity of about 400 incandescent lamps.

Jersey City, N. J.—The Thomson-Houston Electric Co. have secured a contract for the equipment of six cars to be operated on the elevated railway of the North Hudson Railroad Co., which connects the ferry at Hoboken with Jersey City Heights.

Keokuk, Ia.—The street car line has been sold by Commissioner Kenney to S. P. Townsend & Son, of Hartford, Conn., for $21,000. It is said that the line will be put in first class running shape.

Lansing, Mich.—Gordon Macdonald, of New York, has been appointed receiver for the Lansing City Railway Co. The action was taken upon a bill filed by the Continental Trust Co., of New York, to foreclose the mortgage. The present lines will be improved.

Lexington, Ky.—On April 30, fire destroyed the car shed of the Passenger & Belt Railway Co. Three cars were burned.

McKeesport, Pa.—The McKeesport Street Railway Co. have increased the wages of the motormen and conductors from $1.50 to $2 a day. They have also increased the hours of the men from nine to twelve hours a day.

Macon, Ga.—The Macon street car system was sold at auction May 14, to the Thomson-Houston Electric Co., of Boston. The system includes about nine miles of equipped line. The price paid was $200,000. Improvements will be inaugurated at once.

Memphis, Tenn.—A. M. Billings, of Chicago, the owner of all the Memphis street railway lines, has offered to make the city an equal partner in the enterprise. He wants to issue bonds to the value of the street railway plant and franchises, say $1,250,000, which bonds he will take himself, and then issue stock for that amount and give the city half of it.

Minneapolis, Minn.—William J. Hield has succeeded C. G. Goodrich as manager of the street railway.

Mobile, Ala.—The Mobile street railway has been purchased by the New Orleans bondholders.

New Bedford, Mass.—A syndicate of New York capitalists, represented by James Irvine, is endeavoring to purchase the Union Street Railway.

New Haven, Conn.—The West Haven Street Railway Co. expect to have the electric system in full operation by July 1.

New Orleans, La.—The new system on the Carrollton Railroad will be in running order by August 1.

Oakland, Cal.—The formal opening of the Oakland, San Leandro & Haywards Electric Railway took place on the 7th of last month.

Old Town, Me.—The consolidation of the Old Town Street Railway Co. aud the Old Town, Orono & Veazie Railway Co. has been arranged, and it is expected that work on the new electric railway from this city to Bangor will be begun within a short time. Hon. J. M. Haynes of Augusta, is president of the Old Town, Orono & Veazie Railway.

Orange, N. J.—A contract for the completion of the construction of the cable road on Orange Mountain, between Orange Valley and St. Cloud, has been made by the Orange Heights Improvement Co. and John A. Roebling's Sons Co. The road is to be completed by August 1.

Owosso, Mich.—The street railway between Owosso and Corunna is completed and operating successfully.

Peoria, Ill.—The Fort Clark Street Railway electric equipment is complete.

Peterboro, Ont.—The contract has been awarded to the Edison General Electric Co. here for the electric equipments of the Toronto and Montreal street railways.

Philadelphia, Pa.—The contract for the extensionof the Chelten Avenue railway from Chew Street to Stenton Avenue, has been awarded to William Wharton of this city.

Piqua, O.—The Piqua Electric Railway Co. have their new brick power house well under way. The company have purchased a 175 H P. Hamilton-Corliss engine for their dynamos. They have also purchased additional electrical machinery.

Pittsburgh, Pa.—The Federal Street & Pleasant Valley Passenger Railway Co. have purchased ten new cars from the New Castle Electric Car Works, a new concern started within the past year. This company have now a trackage of twenty-eight miles.

THE contract for the equipment of the entire system of the West End Electric Railway was let last month to the Westinghouse Electric & Manufacturing Co. That for the construction has been given to Booth & Flinn.

THE Citizens' Traction Co. have put in new machinery in their Thirty-fourth Street station, including a traveling crane of twenty tons capacity.

Tampa to Ballast Point. The directors of the company are J. Rush Ritter, Alfred G. Clay, Joseph Wright of Philadelphia, Henry Bradstreet of New York and Mr. J. H. Ahren, president of the Florida Electric company of Tampa. The capital to $500,000.

Tonawanda, N. Y.—Application for franchises have been made by both the Buffalo, North Main Street & Tonawanda Electric Railway Co., and the Buffalo, Kenmore & Tonawanda Electric railroad Co.

University Park, Ore.—A movement is on foot for another car line down the Peninsula, independent of the City & Suburban Railway Co. It will be an electric line.

Uxbridge, Mass.—M. P. Burbank is engaged soliciting stock for his proposed electric railroad between Uxbridge and Whitinsville. Mr. Burbank is confident that it will prove a paying investment.

Westchester, N. Y.—Five street railway companies have been incorporated, as follows: The Suburban Traction Co. to construct a road in Westchester County five miles in length. The termini of the main line will be at the junction of the Bronx River and Harlem Road, and the junction of Main Street in the village of West Chester and West Chester Creek. A branch road will be constructed, with termini at the junction of the southern turnpike and the road leading to Crossers Point and the East River. The capital is $150,000.

THE West Farms & Westchester Traction Co., with a capital of $80,000, to construct a road three miles in length in Westchester County. The termini of the road will be the junction of Bronx River and the New West Farms Road, and the junction of Main Street in the village of West Chester and West Chester Creek.

THE Williamsbridge & Westchester Traction Co., with a capital of $80,000, to construct a road four miles in length in Westchester County. The termini of the road will be the junction of Bronx River and Olin Avenue in the village of Williamsbridge, and the junction of Main Street in the village of West Chester and West Chester Creek.

THE Van Nest, West Farms & Westchester Traction Co., with a capital of $150,000, to construct a road in Westchester County five miles in length. The termini of the main line will be the junction of Main Street in the village of West Chester and West Chester Creek. Two branches will be constructed from this main line, the termini being the intersection of the West Farms Road with Bear Swamp Road and a point opposite the Mullaly property on Bear Swamp Road and the intersection of the road leading from Van Nest Station to Bronxdale and the new road now being constructed through the Saggermant farm and the intersection of Avenue C and Second Street in Unionport.

THE Wakefield & Westchester Traction Co., with a capital of $125,000, to construct a road in Westchester County seven miles in length. The termini will be the intersection of Fifteenth Avenue and Third Street in the village of Williamsbridge and the junction of Long Island Sound with the new road between the Eastern Boulevard and Long Island Sound. The directors of each of the five companies are: Howard Carroll, Thurlow Weed Barnes, George C. Clausen, James McNaughton, Frank M. Pierson, George H. Lawrence, Frank P. Statt, William H. Jasper and Charles E. Coddington, all of New York City.

West Chester, Pa.—At a meeting last month of the capitalists interested in the electric railway from Lenape to Unionville, the West Chester, Unionville & Western Railway Co. was organized with a capital stock of $100,000. The affairs of the new company are to be managed by a president and eleven directors. John Henry Marshall of Unionville, was chosen president.

THE West Chester, Unionville & Western Electric Railway Co., with a capital stock of $100,000, is organized and a charter will at once be applied for. The road will run between West Chester and Unionville. John Henry Marshall, of Unionville, was elected president.

White Plains, N. Y.—The New York, White Plains & Mamaroneck Railroad Co. were incorporated lately, with a capital of $90,000, to construct a street surface railroad six miles in length. The termini of the road are in White Plains and the town of Mamaroneck.

THE New York, Elmsford & White Plains Railroad Co. are also incorporated with a capital of $60,000, to construct a street surface road about four miles in length. Each road will have the same directors, among whom are: James H. Morgan and James E. Campbell, of White Plains, and Theodore G. Gross, of New York City.

Williamsport, Pa.—A charter has been obtained for another electric street railway to be known as the Junction Passenger Railway Co.

Worcester, Mass.—The Board of Aldermen have granted the North End street railway company, location for their tracks, from Adams Square through Lincoln and Summer Streets, to the Union station.

Personal.

Mr. J. H. Rose, of the Lima Register Co., was in New York during May.

Mr. C. E. Newton, of the Jewell Belting Co., called at the *World* Building last month while in New York.

Mr. J. H. Shay, of the Charles Munson Belting Co., visited the office of the STREET RAILWAY JOURNAL during May, while on an Eastern business trip.

Mr. J. H. Mason, general manager Simplex Electrical Co., of Boston, spent some time in New York during May. While in the city he visited our office.

Mr. J. F. McGowan, formerly with the Thomson-Houston Electric Co., has accepted a position with the R. D. Nuttall Co., of Allegheny, Pa. and was recently elected secretary and treasurer of that company.

Mr. W. R. Mason, of the Railway Equipment Co., called at our office during last month, and said that the affairs of the Railway Equipment Co. were prospering, and that the company were doing a large amount of business.

Mrs. E. C. Pullman died in New York, May 21. Mrs. Pullman had reached the ripe age of eighty-four years. She was the mother of George M. and C. L. Pullman, to whom we extend our sympathy at their sad bereavement.

Mr. W. F. D. Crane, who has been well known as manager of the railway department of the Engineering Equipment Co., has recently become connected with the H. W. Johns Manufacturing Co., 87 Maiden Lane, New York, and will hereafter have charge of the electrical department of that company.

Mr. Louis Warfield, general manager and treasurer of the Detroit Electrical Works, was united in marriage last month to Miss Alice McMillan, daughter of Mr. Hugh McMillan, of Detroit. Mr. and Mrs. Warfield took a bridal tour in the Eastern states and will reside at 410 Jefferson Avenue, Detroit. We extend to the bridal couple our heartiest congratulations.

Mr. G. S. Duncan, engineer-in-chief of the Tramway Trust, Melbourne, Australia, owners of the extensive cable system in that city, has resigned from active connection with the trust and will make a trip around the world. Mr. Duncan expects to spend considerable time in this country, examining the American street railway systems. Before his departure Mr. Duncan was presented with a handsomely engrossed series of very complimentary resolutions adopted by the directors of the trust in recognition of his services in the installation of the Melbourne cable systems. Mr. Duncan will continue his connection with the trust as consulting engineer during his absence.

New Publications.

Electric Street Railways as Investments, by Lemuel William Serrell, M. E.

This publication contains in pamphlet form an article by Mr. Serrell which was published in the *Engineering Magazine* for May, 1892. It clearly shows that though electric railway securities present a comparatively new field to investors, they are rapidly becoming better known and their value is being better appreciated.

Report of the Boston Rapid Transit Commission to the Massachusetts legislature, transmitted April 5, 1892.

The report, of which we gave an abstract in our last issue, has been published in pamphlet form and presents much interesting and valuable data. Bound in with the report are the reports on foreign transit systems of Messrs. John E. Fitzgerald and Osborne Howes, Jr., the latter being especially complete. Thirty-one plans are also given showing many of the proposed changes and details decided upon.

The Brush Direct Incandescent System, published by the Brush Electric Co., of Cleveland, O.

As a specimen of handsome typographical work this publication would alone attract attention, but in addition it contains many interesting and valuable facts in regard to the direct incandescent system of the Brush Electric Co. After a short description of the direct current incandescent machine, there are given descriptions and illustrations of six complete isolated incandescent electric light plants installed in large office buildings in Kansas City, Omaha, Minneapolis, St. Paul, Montreal and New York, and in two hotels in Japan. Views of the exteriors and interiors of the buildings, interiors of the dynamo rooms and some details of the arrangement of lights are also given. The book also contains several views of different Brush electric machines and one engraving of the Short electric generator for street railway service.

Dictionary of Electrical Words, Terms and Phrases, second edition, by Prof. Edwin J. Houston. Published by the W. J. Johnston Co., Ltd., *Times* Building, New York City. Price, $5.00.

The work bears very little resemblance to the first edition, which was published in 1889 and contained single column pages 5 x 6¾ ins. The first edition is now familiar to electrical readers and has been very serviceable, but the second edition is practically a new book, as it has been entirely rewritten and revised. It will be octavo in size, containing 562 double column pages printed on heavy paper. The words to be defined are printed in black face type and stand out prominently on the page. The definitions are given in two sizes of type, the larger being used for the definitions proper, while the descriptive matter of more general nature is given in a smaller type. The illustrations, which cover a very wide range of electrical apparatus, are 570 in number, while the definitions are given under about 5,000 distinct titles, and nearly as many more titles are entered for the sake of giving cross reference to other titles under which their definition may be found. This new work will prove of great value to electricians and not only show the wonderful growth and richness of the vocabulary of this science but also by providing reliable and current definitions to the words, terms and phrases. Many new terms relating to electrical knowledge are not to be found in the ordinary unabridged dictionaries, and this work removes a most serious obstacle to the general study of electrical science. The work has evidently been prepared with great care and reflects credit both upon the author and publishers, and we bespeak for it a rapid and extensive sale.

A Cable Coating.

Imperial cable coating which has been adopted on a number of cable railways, is made by a combination of natural products extracted from the pine tree. The pyroligneous acids are practically washed out of the tar, which is the body of the coating, and the natural oils are retained, the whole being held in solution by crude turpentine which evaporates when the coating is run on the cable, leaving an oily paste which adheres to the wire rope and penetrates to its core; never hardens, and only wears off from friction. The result is that the cable is furnished with a non-corrosive, waterproof coating and lubricant, which protects the wire as well as pulley wheels and drums.

As this coating is of an oily nature, it must be applied with judgment. It should be fed on the cable in a very thin stream for a couple of turns of the rope and then stopped for four or five turns until the turpentine has evaporated. If treated in this way, it builds up layer upon layer until the rope is filled. If a brush is used to spread the oil around the cable it will adhere more evenly and quickly, and fill the cable quite rapidly.

When this coating is put on an old rope already coated with tar, the latter will dry and flake off, and not until the rope has stripped and the coating can take hold of the wire, will it give perfect satisfaction. The manufacturers of Imperial cable coating are the Imperial Pine Product Co., of 109 West Broadway, New York.

Equipment Notes.

The New Departure Bell Co., Bristol, Conn., are meeting with a large call for their bells for street railway and other uses.

The Jewell Belting Co., of Hartford, Conn., have just filled an order for the Richmond Railway & Electric Co., Richmond, Va., consisting of one 56 inch double main driving belt and six 11 inch dynamo belts.

S. A. Day, of New York, manufacturer of Kerite insulated wires and cables, has removed his New York office from 16 Dey Street to the new *Mail and Express* Building, 166 Fulton Street. Mr. W. R. Brixey, general superintendent, has been appointed general manager *vice* Mr. W. H. Eckert, resigned.

G. F. Whitney, of Boston, manufacturer of soaps, is doing a large business among street railway companies, and manufactures a variety of soaps, wax, etc., which are especially applicable to street railways. He writes us that among his many customers his products are giving good satisfaction.

A. Whitney & Sons, of Philadelphia, are constantly receiving very gratifying letters from their customers all over the country which testify to the character of their wheels. The Whitney wheels have a wide reputation for durability earned, by excellent service during the forty-five years which the company have been in business.

B. W. Payne & Sons have moved their New York office from 45 Dey Street to 41 Dey Street. At this latter address may be found Messrs. Wate and Henry Payne who have charge of the New York branch, and who are always glad to welcome street railway men to their commodious quarters and give them the latest information in regard to belts. These gentlemen report business as excellent.

The Richard Vose Car Spring Co., of New York, are furnishing the J. G. Brill Co. 180 sets of Vose "graduated" springs, Chicago City Railroad Co.'s standard, to be used for the cars now being built for that company. They are also furnishing 150 sets, Vose "graduated" rubber iron cone springs, for the cars now being built by the American Car Co., St. Louis, for the West Chicago Cable Railway Co.

The Interior Conduit & Insulation Co., of New York have recently put on the market an electric motor fan for desk use which is entirely iron clad. There are no moving parts visible to collect dust and dirt, and everything is completely closed, even the commutator and brushes are out of sight. Ball bearings are provided throughout so that no oil is required, and the motor is compact and attractive in appearance. It is built in two sizes; one-twelfth H. P. and one-sixth H. P.

The Duplex Street Railway Track Co., of New York, have the contract for the equipment of over 6,600 ft. of line on the Atlantic Avenue Railroad of Brooklyn, instead of for half a mile as mentioned in our last issue. This track is giving good satisfaction upon the different street railroads where it has been installed, and the officers of the company tell us that their orders are constantly increasing. A mention of some of the recent contracts being executed by this company was given in our last issue, and each month brings new orders to this company.

James A. Trimble, of New York, well known in the trade for the excellent car work, plain and carved mouldings, etc., which he has supplied for the last twelve years, has recently added another department to his busy establishment, that of building cars complete. He writes us that he is now at work upon a number of orders from New York, Jersey City, Sioux City and other places. In addition, he is doing a large business in the sale of complete woodwork ready to go together to construct car bodies of any style or size as well as special parts for repairs.

The Morton Safety Heating Co., of Baltimore, have recently moved to their new offices in the Vansant Building, Baltimore, which has been recently erected and equipped with all modern office improvements. Their rooms are Nos. 12, 14 and 27, at which they are always glad to meet visiting street railway managers and explain their system of stored heat. They write us that they find business excellent, and that many street railway companies are installing the Morton heaters. They are compiling a catalogue which will be ready for distribution early in June.

John Stephenson Co., Ltd., of New York, are employed on many orders for cars in different sections of the country. Their works present a busy appearance to the visitor, and the various cars which are being prepared for shipment attract attention from their handsome appearance. Recent shipments include a number of both open and trail cars for the Watertown, N. Y., street railway. The Stephenson company are also building electric cars, both motors and trailers, for the new Prohibition Park Electric Railway at Staten Island, N. Y., and for the Rochester, N. Y. Railway Co., the Paterson, N. J. Railway Co., the Central Railway Co., of Baltimore, Md., and the West End Railway, of Pittsburgh, Pa

The Campbell & Zell Co., of Baltimore, Md., write us that notwithstanding the recent extensive additions to their works which more than doubles the capacity, they are crowded with orders for Zell improved water tube safety boilers, and have recently closed contracts for the following plants: The Central Railway Co., of Baltimore, Md., 675 H. P.; The Baltimore City Passenger Railway Co., of Baltimore, Md., 1,800 H. P.; the South Park Electric Light Co., of Chicago, Ill., 450 H. P.; the Michigan Brass & Iron Works, of Detroit, Mich., 150 H. P.; besides a number of smaller boilers, including two 40 H. P. boilers for Otto Sutro & Co., and one 25 H. P. boiler for the Thomas Wilson Sanitarium for Children, both of Baltimore. In addition to this they have also contracted with the World's Columbian Exposition at Chicago for 2,500 H. P. Zell boilers for supplying power at the Fair.

J. G. White & Co., of New York, have a large amount of work under way, and are equipping electric roads in all parts of the East and South. Among the contracts recently closed by this company are Wilmington, N. C., five miles track and overhead; Yonkers, N. Y., four and a half miles overhead work, part iron and part octagonal wood poles; Steinway, L. I., five miles of overhead work, and the New Orleans & Carrollton Railroad sixteen miles with iron poles. They are also equipping seven and a half miles of line, part iron and part octagonal wood poles, for the Baltimore Traction Co.; three miles octagonal wood pole construction for the Pawtucket Street Railway, Pawtucket, R. I., and eleven miles iron pole construction for the Central Railway of Baltimore. With the season as yet hardly commenced, such a showing should be very gratifying to this company.

Mr. P. M. McLaren, who has for the last ten years been connected with the Babcock and Wilcox Co. and who is well known among boiler users, is now located at 91 Liberty Street, New York, where he represents "Green's Economizer" for utilizing the waste heat from steam boilers. This economizer has been favorably known among steam users for many years in both Europe and this country. It consists of a set of cast iron pipes arranged in the chimney flue and through which the feed water is forced by the boiler pump or injector. Each pipe is provided with a scraper which is made to travel continuously at a slow rate of speed, the object being to keep the exterior surface clean, soot being a non-conductor of heat. Actual tests show a large saving in fuel by its adoption, and the users of the device include some of the largest manufacturing companies and mills in the country. The Fuel Economizer Co. has been organized with works at Matteawan, N. Y., to build the Green fuel economizer in this country.

The Goubert Manufacturing Co., of New York are making extensive alterations in the premises occupied by them at 32 Cortlandt Street, and have doubled the amount of floor space formerly devoted to the carrying on of their large business. They will hereafter occupy the entire second floor of the building in which they are located. In the new arrangement of things the company will have a large room for exhibition purposes, giving them facilities for the erection and exhibition of the smaller sizes of their well known feed water heater, both vertical and horizontal. The merits of the "Goubert" feed water heater, of which they are the sole manufacturers, are daily becoming more clearly understood and appreciated, the result being seen in a steadily increasing demand. A few of the more important sales which the company have lately made are: Three 1,000 H. P. heaters for the Broadway cable road; six 1,000 H. P. heaters for the Third Avenue cable road; one 1,000 H. P. heater for the New York Mutual Gas Light Co. They have filled orders as well for many smaller sized heaters.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for the new rolling mill which the Waterbury Brass Co., of Waterbury, Conn., will build to replace the one lately destroyed by fire. It is said that this will be the finest rolling mill in the Naugatuck Valley, being 150 x 350 ft., with brick side walls and iron roof trusses covered with the Berlin Iron Bridge Co.'s patent anti-condensation, corrugated iron roof covering. The building will be absolutely fireproof. This company will also design the new power house for the The Newport News (Va.) Shipbuilding & Dry Dock Co. In order to have the building absolutely fireproof no woodwork will be used about the construction, as the side walls will be of brick, the floors of iron and concrete, and the roof will be made with an iron frame covered with the Berlin Iron Bridge Co.'s patent anti-condensation, corrugated iron covering. The steam, compressed air, hot air and electric light plant for the entire shipyard is concentrated in this one building, and it is therefore absolutely necessary that it be fireproof in every particular.

W. R. Fleming & Co., of New York, agents for the well known Harrisburg Foundry & Machine Works' Ide and Ideal Engines have recently moved their office from Fulton Street to the new *Mail and Express* Building on Fulton Street and Broadway. They have also been awarded the contract for installing four Ideal, self-oiling, automatic engines in this building. This firm are also installing two of the Ideal, self-oiling, high speed engines in the new naval observatory at Georgetown Heights, Washington, D. C. As is well known, there is

no more exacting customer than the government, and these engines were selected by Lieut. A. V. Zane, of the naval department at Washington. After bids were received, he visited several cities to investigate the merits of the different engines, and personally visited the engine rooms to see them run. His reason for ordering the Ide engines were, as he expressed it, for their perfectly noiseless running, as the officers in the observatory, in order to use their instruments with accuracy, can have no noise or vibration of any kind (which would affect their proper use) in the building, and on investigation, Mr. Zane thought these engines exactly suited to his purpose.

The Standard Paint Co., of New York, manufacturers of the well known P. & B. water and acid proof insulating compounds, armature and field coil varnish, insulating tapes, etc., report a largely increased demand for their materials. The P. & B. paint is used largely for preserving all kinds of iron work and for protecting iron or wood work to be placed underground, submerged in water or however exposed. The company have recently received a letter from one of the largest electric street railways in the United States, from which we quote the following: "We would say that we have used your regular P. & B. paint, the armature varnish and insulating tape, all of which have given us good satisfaction. On account of our recent fire we were compelled to use a quantity of your armature varnish in the rewinding of all of our armatures, and can only speak in the highest terms of it. This is the second letter of testimonial that we have ever given, and we are not in the habit of doing so, but if this will be of any benefit you can use it." The Standard Paint Co. deserve the success with which they are meeting, and are always pleased to furnish full information upon application of the materials they manufacture.

The Lamokin Car Works, of Philadelphia, have sent us a list of some of the recent orders closed by them, from which it can be easily seen that the cars of this company retain the popularity which they have always enjoyed. These orders include one for the Schuylkill Electric Co., of Pottsville, Pa., for two sixteen foot vestibule car bodies with vestibule observation windows and mounted upon Peckham trucks, a second order from the City Passenger Railway Co , of Altoona, Pa., for three eight seat open trail cars; one from the East Harrisburg Street Railway Co,, of Harrisburg, Pa., for four thirty-three foot closed car bodies to be mounted on Robinson radial trucks, and a second order from the Akron Street Railway Co,, of Akron, O., for five nine seat, closed end and open car bodies. This company have sent us copies of a number of letters recently received by them from customers speaking in the highest terms of the Lamokin cars. Among others are testimonials from the following: The Danville (Va.) Street Railway Co., the Derby (Ct.) Street Railway Co., the Williamsport (Pa.) Street Railway Co., the Akron (O.) Street Railway Co., the City Passenger Railway Co., of Altoona, Pa., and the Salem (O.) Electric Railway Co.

The Page Belting Co., of Concord, N. H., have sent us a list of some of their recent orders, from which it is very easy to see that the belting manufactured by this company retains the popularity which it has always enjoyed. Among their recent orders for Eureka dynamo belts we notice prominently nine belts to the Brooklyn City Railway Co., of Brooklyn, N. Y., four to the U. S. Electric Light Co., Washington, D. C.; two to the Staten Island Light, Heat & Power Co., Port Richmond, N. Y.; three to the Prudential Insurance Co., Newark, N. J. Among recent orders filled by them for their regular dynamo double belting is one for the People's Electric Light Co., Trenton, N. J., and one for the Red Star Line repair shops, Jersey City, N. J. Other sales have been as follows: A thirty-four inch main belt and several other belts for the Nordberg Manufacturing Co., Webster City, Ia.; a twenty-nine inch belt for the Pontoosuc Manufacturing Co., Pittsfield, Mass.; a complete new mill outfit, including a twenty inch main belt for the Point Pleasant Furniture Co., of Point Pleasant, W. Va. They have also recently furnished for a plant in South Dakota which has probably the largest link belt ever made, it being 181 ft. long and twenty-eight inches wide.

The Haskin Wood Vulcanizing Co., of New York, have a process of vulcanizing wood for ties which they claim greatly increases its life. It has long been known that the charring of lumber, if properly done, will greatly increase its ability to resist the deteriorating effect of the weather. The method adopted by the Haskin Wood Vulcanizing Co., however, is an improvement on the old charring method, inasmuch as the timber is placed in an airtight retort and subjected to a heavy pressure in superheated air, the temperature of which varies from 200 to 600 degs. By this means the entire body of the lumber is treated, accomplishing the same result which the charring process does within a short distance of the surface, and without losing any of the juice or chemical properties of the wood. In addition the extra heat tends to kill all the germs which may be found in wood, and whose presence and life are a menace to its life and fibre. Ties vulcanized by this process have been long in successful use upon a number of railways. Ten years ago 1,000,000 ft. of lumber treated by this process was installed on the elevated railway system of New York as an experiment, and placed alongside of untreated lumber put in at the same time. After four years the untreated lumber had to be renewed, while that which had been vulcanized is still in use, and, it is said, as sound as when first installed. Another item of saving shown on the same road was that the treated lumber resisted the tendency of the rail to cut the surface, for instance, at the top of the ties, and that it did not require to be painted as protection against the weather. The New York, Lake Erie & Western Railroad have employed some of these ties in Jersey City and they are still in service after nine and a half years of service.

The Ball Engine Co., of Erie, Pa., manufacturers of the Ball automatic cut-off engines, have furnished us with the following list of engines for electric railways which they have lately received orders for: Prohibition Park & Staten Island Railway Co., Staten Island, N. Y., one 130 H. P. engine; Baltimore Traction Co., Baltimore, Md., two 130 H. P. engines; North Avenue Street Railway Co., Baltimore, Md., two 130 H. P. engines; Shamokin Street Railway Co., Shamokin, Pa., one 130 H. P. engine; Sandusky Street Railway Co., Sandusky, O., one 100 and two 130 H. P. engines; Rome Street Railway Co., Rome, Ga., two 100 H. P. and one 130 H. P. engines, and complete steam plant; Erie Electric Motor Co., one 450 H. P. tandem compound condensing engine and complete condensing apparatus of 1,000 H. P.; Fresno Electric Railway Co., Fresno, Cal., two eighty H. P. tandem compound engines; Buffalo, Bellevue & Lancaster Railway Co., Buffalo, N. Y., one 150 H. P. engine; Niagara Falls Street Railway Co., Niagara Falls, N. Y., two 130 H. P. engines and complete steam plant; Wilmington Street Railway Co., Wilmington, N. C., two 130 H. P. engines and complete steam plant; North Hudson County Railway Co., Hoboken, N. J., one 250 H. P. engine; Portland Street Railroad Co., Portland, Me., one 250 H. P. engine; Santa Cruz Railway Co., Santa Cruz, Cal., one 200 H. P. cross compound engine; Stockton Street Railway Co., Stockton, Cal., three 200 H. P. tandem compound engines; Schuylkill Electric Railway Co., Pottsville, Pa., one 250 H. P. engine; Westminster & Vancouver Tramway Co., New Westminster, B. C., three 150 H. P. engines. Recent shipments by the Ball Engine Co. include the following: J. C. Hubinger Co., Keokuk, Ia., one 300 H. P. cross compound engine and condenser; Chesapeake Light & Power Co., Hampton, Va., two 150 H. P. tandem compound engines and transmitting machinery; Moundsville Electrical Co., Moundsville, W. Va., one 130 H. P. simple engine; Electric Light Co., Elizabeth, N. C., one 100 H. P. simple engine; Edison General Electric Co., State House, Trenton, N. J., one thirty-five H. P. simple engine; Schuylkill Electric Railway Co , Pottsville, Pa., one 250 H. P. simple engine; Electric Light Co., Doylestown, Pa., one 130 H. P. simple engine; Freeport Gas & Electric Light Co., Freeport, Ills., one 130 H. P. simple engine; Warrenton Electric Light Co., Warrenton, Mo., one fifty H. P. simple engine.

WESTERN NOTES.

The National Electric Manufacturing Co., of Eau Claire, Wis., are doing quite a large business in electric railway power plants.

The Griffin Wheel & Foundry Co., have moved their Chicago office from Room 602, Phœnix Building, to Room 508 in the same building.

Kohler Bros., of Chicago, are now located in their new offices, 1,417 and 1,418 Monadnock Building, and report an active demand for Eddy motors.

The Short Electric Railway Co., of Cleveland, have moved their Chicago office from 225 Dearborn Street to the new Monadnock Building, corner of Dearborn and Jackson Streets.

The Fort Wayne Electric Co., have moved their New York office to 42 and 44 Broad Street, where they have secured large and commodious quarters. Their New York agent is H. C. Adams.

E. G. T. Colles & Co., of Chicago, are making heaters and purifiers which, on account of their substantial and well planned construction, are giving great satisfaction to operators of electric plants.

The Central Electric Co., of Chicago, are selling large quantities of Okonite cable, and are doing an active business in interior conduit specialties. The company's street railway goods are deservedly popular.

Louis Blatz of 107 West Monroe Street, Chicago, is making several specialties which are of interest to electric railway companies. They include trolley wheels, electric railway switches, graphite bushings, etc.

Frank Bakeman & Co., Rookery, Chicago, general agents for the Schuttler Manufacturing Co., are receiving large orders for the Schuttler ratchet drill which is a tool especially adapted to street railway work.

The Electrical Supply Co., of Chicago, are finding that their pocket edition of catalogues meet with a very favorable reception. These miniature books contain many valuable facts and form very interesting reading.

The Great Western Electric Supply Co., of Chicago, now occupy practically the whole of the second floor of the Springer Building, 195—207 South Canal Street and are selling a large amount of goods to street railway companies.

The Hill Clutch Works, of Cleveland, O., have secured, through their Chicago representative, Charles B. Coon, the contracts for furnishing the power transmission machinery in the Germania Theatre and Produce Cold Storage Co's. plant, Chicago.

The Patton Motor Manufacturing Co., of Chicago, recently shipped a pioneer motor of the latest improved type to Portland, Ore., as a sample car for the Pacific Coast territory. They also expect to ship two motors to Denver, Colo., for the Denver, Lakewood & Golden Railroad Co. about June 1.

The Nordberg Manufacturing Co., of Milwaukee, are receiving a large number of orders for the Nordberg poppet valve engine. They are used in a great many electrical stations. The demand for the Nordberg governor is active, and the factory is kept running day and night to keep up with the demand.

The Allen Paper Car Wheel Co., of Chicago, continue to receive orders from street railway companies for their well known wheels. Experience has shown that companies whose roads are mechanically operated need first class wheels, and increasing sales of the Allen wheels in the street railway field may be expected.

The Northern Car Co., of Minneapolis, lost a good part of their plant by fire on the morning of May 7. Many finished and partly finished cars were also destroyed by the flames, including a number of cars for St. Paul and Rockford, Ill. The loss was fully covered by insurance. Not discouraged by their disaster, the company determined to immediately rebuild, and expect soon to be in shape for business again.

The Laclede Car Co., St. Louis, are at present working day and night. Among their recent orders are 10 sixteen foot electric cars for the Lincoln Street Railway, Lincoln, Neb.; twenty of the same size for the Pittsburgh Traction Co., of Pittsburgh, Pa., and two for the Marion Street Railway Co., of Marion, Ind., to be mounted on McGuire trucks.

N. W. Harris & Co., of Chicago, have purchased $250,000 of the first mortgage, 6 per cent. bonds of the consolidated street railways of Sacramento, Cal. The system earned last year $41,848 over operating expenses and taxes. The principal part of the proceeds of the bonds is to be used in completing the electrical equipment of the road. Chicago is recognized as one of the best markets in the country for street railway bonds.

The Kuhlmann Co., of Cleveland, O., have just completed the construction of one dozen closed electric car bodies eighteen feet in length, for the East Cleveland (O.) Railroad Co., among their other orders. These cars are reported to be giving very good satisfaction. The Kuhlmann Co. make a specialty of building complete car bodies ready to receive the truck, and guarantee the lowest possible price consistent with good material and workmanship.

Cummings & McCoy, of Detroit, have just opened an office at 25 Cleland Building. They are general contractors, but make a specialty of laying all kinds of underground electric wires and cables. Mr. Cummings has had a broad experience in electrical work, as for five years he was connected with the Edison company, during which time he had charge of laying Edison mains, and also the installation of electrical apparatus. The firm have in prospect considerable work in Detroit.

The Lima Register Co., of Lima, O., have a register which they claim is simpler, more positive in action and more durable than any other. There is no glass to break, the register can be set to zero each trip, it embosses on a slip or card its number and the number of fares collected, and cannot be manipulated. The dial is ten inches in diameter, so can be readily seen. Among the street railway companies which have used it and sent testimonials to the manufacturers of its value are the White Line Street Railway Co., of Dayton, O., and the Toledo (O.) Consolidated Street Railway Co.

E. P. Allis & Co., of Milwaukee, are receiving a large number of orders for engines. During the last two months the demand for engines of large sizes has been extraordinarily great. Among the railway companies who have recently ordered engines of the company are the following: Washington & Georgetown Railway Co., two 1,000 H. P. and one 500 H. P.; Duluth Street Railway Co. one 1,200 H. P. compound; Baltimore City Passenger Railway Co., two 700 H. P. and two 500 H. P.; Houston City Street Railway Co., one 250 H. P. compound; Milwaukee & Wauwatosa Railway Co. two 125 H. P.; Atlanta & Chattahoochee Street Railway Co., two 150 H. P.; Brooklyn City Street Railway Co., four 900 H. P.

Frank B. Rae, of Detroit, has removed his office from the Hammond Building to Nos. 26 and 28 Cleveland Building. The change was necessitated by the growth of Mr. Rae's business, which is that of an expert and independent electrical engineer. He has many installations in which he is acting as consulting engineer, among them being one for the City of Detroit to supervise the installation of an electric light plant at Belle Island Park. He is also installing a 400 to 600 incandescent lamp light, and a 40 arc light plant in the new Union Depot at Detroit. Among other work he has been engaged in designing apparatus for the Nicholson Hoisting Co. Mr. Rae has had a broad experience in all classes of electrical engineering, and is well qualified to act as the confidential adviser of those intending to install electric railway light and power plants.

The Walker Manufacturing Co., of Cleveland, are extremely busy in supplying machinery for the many cable lines upon which they have received orders. They write us that they are just finishing the machinery for the Catskill Mountain road referred to in a recent issue, are engaged in building the new machinery for the Mount Auburn cable road at Cincinnati, which was recently destroyed by fire, and are at work on considerable cable machinery for Chicago and New York. As an instance of the popularity of the apparatus manufactured by this company it need only be said that they have orders at present for forty-eight of their patent differential drums, four of which are for Sydney, Australia. This company sent out a general invitation to their friends to inspect the thirty-two foot rope pulley which they have recently built for the Broadway (N. Y.) cable railway, which was on exhibition at their works during the first two weeks of May.

The Detroit Electrical Works, owing to the grest press of Eastern business, have found it necessary to open a New York office, which has been located in the Metropolitan Telephone & Telegraph Building, 18 Cortlandt Street, New York City. This office is in charge of Mr. T. W. Warfield as district manager. They have also opened an office in Boston in No. 23 Fiske Building. This company find the demand for goods of their manufacture in the East to be very great, and for the convenience of the Eastern trade have made provision as above, that information respecting their apparatus may be obtained on short notice. The opening of these Eastern offices, when taken in connection with the large extensions they are making to their factory, will enable them to handle a large business in a manner that cannot fail to be satisfactory to their patrons. In another column we give an account of an extensive contract which they have recently secured in Detroit, Mich. As this contract is only one of a number that have lately been awarded the Detroit Electrical Works in face of a sharp competition by manufacturers of other electric railway apparatus, it shows plainly that this company are fully substantiating their claims in regard to their equipment.

The Brightman Stoker Co., Cleveland, O., are equipping many plants with their mechanical stoker and smoke preventing furnace. Among other orders received are the following: From Carnegie, Phipps & Co., (second order) and Booth & Flinn, Pittsburgh, Pa.; Otis Steel Co., Cleveland, O., (second order); Goodrich Hard Rubber Co., Akron, O.; Western Iron Co., Butte, Mont., (second order); Ottumwa Electric Railway Co., Ottumwa, Ia., (second order); Evansville Street Railway Co., Evansville, Ind.; Jackson Electric Light Plant, Jackson, Mich. Superintendent Tharp of the water department, Cincinnati, O., is reported as writing to the Board of Administration that since 1,200 H. P. Brightman stokers and water tube boilers were introduced the same work is now being done that formerly required 1,600 H. P. with old style boilers and hand firing, the price being $248.37 now, against a previous price of $357.52, or a total saving for the year of $39,839.75. Regarding the prevention of smoke Superintendent Tharp writes: "Where 1,600 H. P. of old boilers were in service using the best and most expensive quality of coal to operate the Front Street station, each smoke stack contributing a volume of dense black smoke and soot to the discomfort and expense of the entire neighborhood, now, with the services of 1,200 H. P. new boilers, with improved furnaces, and using inferior quality and least expensive of coal, no smoke whatever can be discovered, except occasionally when cleaning the fires."

The Sioux City Engine Works, of Sioux City, Ia., have been running a full night and day force for the past two months, and have a large stock of engines on hand ready for prompt delivery. They have recently received orders for a 22 x 48 Corliss engine for the U. S. Electric Light Co., of Dubuque, Ia.; one 24 x 48 for the Rhomberg street railway line of Dubuque, Ia.; one 36 x 42 to be used as a twin compound with an 18 x 42 in the Sioux City Electric Light & Power Co.'s works; one 9 x 14 automatic for the Hotel Garretson of Sioux City, and one 9 x 14 automatic for the Hotel Delone of Omaha, Neb. They will soon ship to R. D. Hubbard of Mankato, Minn., one 150 H. P. compound, automatic engine. They are now erecting for the B. & M. Ry. Co., at their new shops at Havelock, Neb., one 18 x 42 Corliss engine, and also one 100 H. P. compound, automatic for the State University at Lincoln, Neb. They have recently started one of their 18 x 42 Corliss in the new factory of Sparr & Weiss, Milwaukee Avenue, Chicago; also a 12 x 36 Corliss in the new factory of Ole Berg, West Side, Chicago; also one 14 x 36 Corliss for Blakeman & Dobson, Rockford, Ill. These people have largely extended their selling department, having selling agencies in Minneapolis, Chicago, St. Louis, Omaha, Kansas City, Dallas and Denver, and have every prospect of the largest output by far of any previous year. They have recently been adding some very large tools to their equipment, and are prepared to make figures on engines up to 1,000 H. P. capacity.

The Railway Equipment Co.

It gives us pleasure to record the prosperous condition of the Railway Equipment Co., of Chicago. The advent of this company, about four weeks ago, has been quite generally mentioned by the trade papers. In the interest of our readers we review the purposes and features of the new company, as stated by the manager, Mr. W. R. Mason. The company will give their whole time and attention to furnishing electric railway supplies. At present their offices are at No. 11 Adams Street, the old quarters of the Electric Merchandise Co., but more convenient and pleasant warerooms are now being fitted up. A complete stock of electric railway material will at all times be carried, and all orders will be filled immediately therefrom. The trade will have increased confidence in the excellence of the material handled by the new company, from the fact that the Electric Merchandise Co. has been purchased by them and shipments will be made from the large stock of the old concern, the quality of which is well known.

Besides the Electric Merchandise Co.'s goods, the Railway Equipment Co. will handle many new and improved devices, the merits of which it is believed will be generally appreciated as soon as tried. The manager of the company, who for several years past has been connected with the Electric Merchandise Co. as president and general manager, holds similar relations with the new company, while his staff inciudes the experienced assistants of the former company. The trade will thus discover in the new venture many old friends upon whom they may place reliance. A new and complete catalogue of electric railway material, with much valuable information regarding the building of electric railways is in course of preparation and will soon be ready for distribution, and everything is being done to place the new house in good working order. A large number of orders have already been filled and the company solicit the correspondence of the trade, and offer their counsel and services to all who desire it in the selection of the latest and most approved railway specialties.

The Providence and Stonington Lines.

The Providence & Stonington Steamship Co. gave a trial trip of their new steel steamer "New Hampshire," May 7, and since that time this steamer has been put into commission between New York and Stonington. The same company on May 9 reopened the popular Providence Line between New York and Boston.

The Robinson Radial Truck.

The Robinson Electric Truck & Supply Co. have delivered all or nearly all of the forty Robinson radial trucks which they contracted to build for the Brooklyn City Railroad Co. and most of these have already been put under the forty cars built for them by the Lewis & Fowler Manufacturing Co., of Brooklyn and J. M. Jones' Sons, of Troy.

In addition to these, the Robinson company have a number of large orders for trucks from companies in various parts of the country for both open and closed cars.

Some important and interesting information has recently been gained in regard to the economy of the operation of the Robinson radial truck. In September last, a test was made on the West End Railway, Boston, of one of the Robinson radial cars in which the car, loaded with 15,000 lbs. of meal, was run over the line with one fifteen H. P. motor. No difficulty was found in making time over the line which included a long 6½ per cent. grade. This test was so satisfactory, that in January last, another of the Robinson radial cars had its two fifteen H. P. motors taken off and these were replaced by a single twenty-five H. P. motor geared to only one driving axle.

The result of these two tests has been that the West End road is changing over all the Robinson radial cars, putting one twenty five H. P. motor on instead of the two fifteen H. P motors heretofore used.

Up to the present time, some twelve or fifteen of the radials have been thus changed. It is found that a single driving axle on the Robinson radial gives all the traction necessary for driving the car under all conditions of summer traffic. The reason of this is apparent, since substantially the whole weight of the car and its load is carried on the two axles heretofore used as drivers; hence each driving axle has one-half the weight of the car and its load for traction. In an eight wheeled car, with two driving axles, the same proportion, *i. e.*, just one-half the weight of the car and its load, is available for traction, so that with one driving axle the Robinson radial secures as much traction as the eight wheeled cars with twice the number.

The ability of the Robinson radial car to run so efficiently with one motor geared to a single driving axle is a revelation to all conversant with the operation of motor trucks in general. There are at present fifty radials on the West End Railway, of Boston, and the company have been making a number of experiments with a radial truck of their own manufacture, patterned in many respects after the Robinson, proving their great confidence in the radial principle.

Detroit Electrical Works.

At the annual meeting of the stockholders of the Detroit Electrical Works, held April 26, the following named gentlemen were elected directors to serve during the ensuing year: Messrs. Hugh McMillan, W. H. Wells, T. H. Newberry, Gilbert N. McMillan, James H. McMillan, Strathearn Hendrie, Louis Warfield, all of Detroit, and Albert A. Pope and George B. Strong, of Boston.

The directors elected the following officers: Hugh McMillan, president; Louis Warfield, vice-president and general manager; Jos. E. Lockwood, secretary; Thomas Muir, treasurer; H. C. Van Husen, assistant secretary.

In a recent issue of the Detroit *Evening News* the following interesting statements were made about this company:

The original location of the works and general offices was at the corner of Seventh and Woodbridge Streets, but in the fall of 1890 was removed to the location now occupied. When the company was first incorporated a small factory was found sufficient for the requirements of the business, but this was soon enlarged until, when the factory was removed to its present location, a building covering ground space 150 x 120 ft., the greater portion of which is three stories high, was found necessary to meet the requirements of the business. To this is now being added a three story structure 100 x 120 ft., which will give this company the largest factory facilities of any electrical institution in Michigan, and one of the largest in the country. The machinery and appliances with which the factory is equipped are of the best and latest design; the arrangement of same and general details of the shop being such as will compare with any factory in the country. The steam engines, which furnish the power to operate this factory, instead of being belted to the shafting, on the old plan, are belted direct to electric generators, the current from which is distributed through the factory by means of wires and used to operate electric motors, each department being equipped with one of these, so that each is independent, and can start or stop its machinery at will, this plan being the most economical for the distribution of a large amount of power throughout a large factory. When the new building is completed there will be in use three engines aggregating 500 H. P. The official management is characterized by an enterprising and judicious direction, and the industry justly takes rank among the largest and most important of its character in the world. The business now includes manufacturing electrical supplies for every department of applied electricity, such as apparatus for electric street railways, electric lighting, electric motors, telephone equipments and general electrical supplies. The electric railway machinery and appliances that this company manufacture are in use upon twenty-nine street railways, which are distributed from Michigan to Texas and from Maine to California. The company are preparing to take up every special application of electricity and furnish machinery and appliances to meet any requirements. The operation of such an immense industry in Detroit means to this city a valuable acquisition, and one which must appreciably advance and fortify its leading and general commercial situation.

List of Street Railway Patents

ISSUED BY THE U. S. PATENT OFFICE, APRIL 26, 1892, TO MAY 17, 1892, INCLUSIVE.

APRIL 26.

Cable Railway Switch, Ira Bishop and Arthur F. L. Bell, San Francisco, Cal. ... 473,652
Car Brake, Horace P. Bassett, Warren, O. ... 473,606
Brake Mechanism for Street Cars, Harry H. Kelly, Willoughby, O. ... 473,510
Electric Locomotive, Sidney H. Short, Cleveland, O. ... 473,674
Electric Locomotive, Joseph I. Conklin, Brooklyn, N. Y. ... 473,693
Fare Box, Samuel O. Tuerk, Fulton, N. Y. ... 473,680
Mechanism for Operating Brakes, George Harrison, Cleveland, O. ... 473,553
Mechanism for Propelling Vehicles, Isaac B. Jones, Xenia, O. ... 473,843
Rail Joint, Milton C. Niles, Oak Park, Ill. ... 473,638
Safety Catch for Inclined Railways, Davis James and Thomas James, Wadsworth, O. ... 473,842

MAY 3.

Bicycle Electric Car, Eben M. Boynton, West Newbury, Mass. ... 474,331
Cable Grip, Theodor Otto, Scheuditz, Germany ... 474,185
Car Brake, John W. Neumann and John R. Pflanz, Louisville, Ky. ... 474,261
Car Heater, Cyrus S. Dean, Fort Erie, Canada ... 474,225
Combined Rail Brace and Truss Fastening for Rail Joints, Frederick H. Heath, Minneapolis, Minn. ... 474,128
Conduit Trolley, James J. Cosgrove, Jr., Philadelphia, Pa. ... 474,218
Electric Motor Mechanism, Samuel E. Mower, New Haven, Conn ... 474,328
Grip Mechanism for Cable Railways, William Hewitt, Trenton, N. J. ... 474,249
Insulating Support for Electric Railway Wires, Abraham A. Shobe, and William Embley, Jerseyville, Ill. ... 474,049
Mode of Arresting Electric Locomotives, Sidney H. Short, Cleveland, O. ... 474,031
Rail Chair, Tie Plate, Truss Joint and Joint Fastening, Frederick H. Heath, Minneapolis, Minn. ... 474,127
Rail Joint, Frederick H. Heath, Minneapolis Minn. ... 474,129
Trolley Wire Circuit Breaker, Johan M. Andersen, Boston, Mass. ... 474,037
Truss Rail Joint Fastening, Frederick H. Heath, Minneapolis, Minn. ... 474,126

MAY 10.

Cleaning Brush for Electric Railways, Rudolph M. Hunter, Philadelphia, Pa. ... 474,472
Electric Railway, Charles H. Baker, Lake Geneva, Wis. ... 474,355
Rail Brace, George H. Mason, Rochester, N. Y. ... 474,560
Railway Car, John Hammond, San Francisco, Cal. ... 474,736
Rail Joint, James C. Gentry, Monroe City, Mo. ... 474,499
Trolley for Electric Railways, Charles E. Friel, Boston, Mass. ... 474,552
Trolley Wire Support, Owen F. Evans, Columbus, O. ... 474,375
Truck for Electrically Propelled Vehicles, Louis Pfingst, Boston Mass. ... 474,402

MAY 17.

Anti-Friction Bearing for Cars, Carl F. Buschner, New York ... 475,007
Cable Car Grip, David D. Nolley, Wilson, N. C. ... 475,143
Cable Railway Grip, John C. H. Stut, San Francisco, Cal. ... 474,875
Device for Bending Electric Trolley Wires, Henry D. Winton, Wellesley, Mass. ... 475,261
Electric Locomotive, Charles Brown, Naples Italy, and Gustav J. Melms, Chicago, Ill. ... 474,984
Electric Motor Mechanism, Elbert B. Phillips, Cleveland, O. ... 474,857
Electric Railway, John W. Grantland, Philadelphia, Pa. ... 475,107
Electric Railway Motor, Sidney H. Short, Cleveland, O. ... 475,160
Grip Car Brake, William Byrnes, Chicago, Ill. ... 474,900
Insulated Gear Wheel, George F. Lockwood, Saginaw, Mich ... 474,913
Railway System, Hugh T. Dunne, New York ... 474,951
Street Car Curtain, Arthur D. Cochran, Indianapolis, Ind. ... 474,902
Tramway Brake, Friedrich Adler, Prague, Austria-Hungary ... 475,171

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of twenty-five cents. Give date and number of patent desired. STREET RAILWAY PUBLISHING COMPANY, WORLD BUILDING, NEW YORK.

In Memory of Jacob Barnsley.

At a special meeting of the Charles Munson Belting Co., May 17, the following resolutions were adopted:

WHEREAS, it has pleased an all-wise Providence to remove from our midst, after a short illness, Mr. Jacob Barnsley, late director and superintendent of the Charles Munson Belting Co.; and

WHEREAS, It is but just to the memory of our departed friend and co-worker that a fitting recognition of his many virtues should be had; therefore, be it

Resolved, That in the death of Mr. Jacob Barnsley this company has lost an officer to whose energy and keen business foresight is principally due the great success of our enterprise; that we bear willing testimony to his many sterling qualities of head and heart by which he had endeared himself to all with whom he came in contact, and, while missing his good counsel and advice hereafter, we shall always cherish his memory.

Resolved, That our heartfelt sympathies be extended to his family in their affliction.

Resolved, That these resolutions be spread upon the minutes of this company and a copy thereof be transmitted to the family of our deceased friend and co-worker.

Resolved, That the employes of the company attend the funeral in a body.

QUOTATIONS OF STREET RAILWAY STOCKS.

BROOKLYN STOCKS AND BONDS.—Corrected by C. E. STAPLES & Co., 215 Montague Street, Brooklyn, May 18. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Atlantic Avenue R. R. Co ...	50	1,250,000	Q.—J.	1½	.....	107	.....
Broadway R. R. Co	100	525,000	Q.—F.	2	.....	185	.....
Brooooklyn City R. R. Co. ...	10	6,000,000	Q.—J.	2	.....	176	178
Coney Island & Brooklyn R R. Co.....	100	500,000	.....	...	.....	125	.....

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Atlantic Ave. R. R. Co., 1st mort.....	.....	140,500	M. & N.	7	May. 1894	104	.....
Atlantic Ave. R. R. Co. Cons.	.....	900,000	A. & O.	5	Oct. 1909	.....	106
Broadway R. R. Co.....	.....	350,000	J. & J.	5	6 m. notice	100	.....
Coney Island & Brooklyn R. R. Co., 1st bonds.....	.....	300 000	J. & J.	5	Jan. 1909	.....	103
Coney Island & Brooklyn R. R. Co., certificates.....	.....	300,000	J. & J.	6	July, 1894	10)	.....
South Brooklyn Central R. R. Co., 1st.....	.....	125,000	F. & A.	7	Aug. 1897	107	.....
South Brooklyn Central R. R. Co., 2d.....	.....	150,000	F. & A.	6	July, 1941	103	.....
Brooklyn City R. R. Co., 1st	.....	3,000,000	J. & J.	5	July, 1916	108	.....

ALBANY STOCKS AND BONDS.—Corrected by SPENCER TRASK & Co., Bankers and Brokers, corner State and James Streets, Albany, N. Y., May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Albany R. R. Co.....	100	750,000	Q Feb.	1½	1890	113	115
Watervleit Turnpike & R. R. Co.....	100	240,000	.....	...	1863	10	15

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Albany R. R. Co., 1st Mort...	1865	40.000	J. & J.	5	1905	103	.....
" " " 2d Mort....	1873	20,000	M. & N.	7	1893	102	.....
" " " 3d Mort....	1875	28,500	J. & J.	7	1895	105	.....
" " " 4th Mort...	1880	11,500	M. & S.	6	1905	105	.....
" " " 5th Mort...	1888	50,000	M. & S.	5	1913	105	.....
" " " Consol Mtg	1890	350,000	J. & J.	5	1930	103	104
" " " Debenture..	1891	200,000	M. & N.	6	1901	109	110
Watervliet Turnpike & R. R., 1st Mort.....	1889	350,000	M. & N.	6	1919	110	.....
Watervliet Turnpike & R. R., 2d Mort.....	1889	150,000	M. & N.	6	1919	105	.....

NEW YORK STOCKS AND BONDS.—Corrected by H. L. GRANT, 26 Broad St., New York, May 18. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Bleecker St. & Fulton Ferry...	100	900,000	J. & J.	¾	.....	27	29
Broadway & Seventh Avenue..	100	2,100,000	Q.—J.	2	.....	197	200
Cen'l Park, North & East River	100	1,800,000	Q.—J.	1	.....	120	123
Christopher & Tenth..... ..	100	650,000	F. & A.	1¾	.....	134	135
Central Crosstown.....	100	600,000	Q.—F.	1¾	.. ..	140	.....
Dry Dock, E. B'way & Battery.	100	1,200,000	Q.—F.	2	.....	115	118
42d & Grand St. Ferry.....	100	748,000	Q.—F.	3	.....	250	.....
42d St., Manhat. & St. Nich. Av.	100	2,500,000	.....	...	.....	47	50
Eighth Avenue.....	100	1,600,000	Q.—J.	2	.....	240	.....
Houston, W. St. & Pav. Ferry. Leased to B'way&7ave.....	100	1,000,000	Q—F.	2	.....	200	.....
Second Avenue.....	100	1,862,000	J. & J.	5	.....	106	108
Sixth Avenue.....	100	1,500,000	M. & S.	3	.....	190	200
Third Avenue.....	100	2,000,000	M. & N.	6	.....	230	.....
23d St.....	100	600,000	Q.—F.	2½	.....	250	.....
Ninth Avenue.....	100	800,000	.....	3	.....	128	133

Bonds.	Date of Issue	Amount.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Bleecker St. & Fulton Ferry...	.....	700,000	J. & J.	7	July, 1900	113	116
B'way & 7th Ave., 1st mort....	.....	1,500,000	J. & D.	5	June, 1904	105	.....
2d mort.....	.....	500,000	J. & J.	5	July, 1914	104	.....
Broadway Surface Guaranteed	.....	1,500,000	J. & J.	6	July, 1924	105	.....
Additional.....	.....	1,000,000	J. & J.	5	July, 1905	95	.....
Cen'l Park, North & East River	.....	1,200,000	J. & D.	7	Dec., 1902	116	120
Christopher & Tenth.....	.....	250,000	A. & O.	7	Oct., 1898	108	110
Central Crosstown.....	....	250,000	M. & N.	6	Nov., 1922	115	117
Dry Dock, E. B'way & Battery. 1st mort.....	.....	840,000	J. & D.	7	June, 1893	100	101
Scrip.....	.....	1,200,000	F. & A.	6	Aug. 1914	101	.....
42d & Grand St. Ferry.....	.....	236,000	A. & O.	7	April, 1893	100	103
42d St. Manhat. & St. Nich. Av 1st mort.....	.....	1,200,000	M & S.	6	Sept., 1910	110	112
2d mort.....	.....	1,200,000	J. & J.	5	1915	55	57
Eighth Ave., Scrip.....	.....	1,000,000	F. & A.	6	Aug., 1914	105	109
Houston, W. St. & Pav. Ferry.	.....	250,000	J. & J.	7	July, 1894	100	107
Second Avenue.....	.....	1,600,000	M. & N.	5	Nov., 1909	102	103
Third Avenue.....	.....	5,000,000	J. & J.	5	Jan., 1937	112	114
23d St.....	.....	250,000	M. & N.	7	May, 1893	102	104

BOSTON STOCKS.—Corrected by R. L. DAY & Co., 40 Water Street, Members of Boston Stock Exchange. May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
West End Pref.....	50	$6,406,000	J. & J.	4	1887	88¾	89
West End Com'n.....	50	$7,150,000	J. & J.	5	1890–1891	74⅞	75

PROVIDENCE STOCKS.—Corrected by CHACE & BUTTS, Bankers, Providence, May 18.

Company	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
Pawtucket St. Ry. Co.....	100	$270,000	New.	...	Oct., 1887	94	96
Union R. R. Co., Prov.....	100	2,000,000	Q.—J.	2	1862–1863	196	200
Providence Cable Tramway ..	100	300,000	Owned by Union Railroad Co.				

HOLYOKE STOCKS.—Corrected by J. G. MACKINTOSH & Co., Bankers, Holyoke, Mass. May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issuc.	Bid.	Ask'd
Springfield Street R. R. Co....	100	$360,000	J. & J.	4	.....	245	250
Holyoke Street R. R.....	100	200,000	J. & J.	4	.....	200	225
Northampton Street R. R.....	100	50,000	.....	...	.....	25	50

CHARLESTON STOCKS AND BONDS.—Corrected by A. C. KAUFMAN, Charleston, S. C., May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Charleston City Ry. Co.....	50	$100,000	J. & J.	3	.....	.....	65
Enterprise Ry. Co.....	25	250,000	.....	...	.....	.....	8

BONDS.	Date of Issue	Amo'nt Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Charleston City Ry. Co	.....	100,000	J. & J.	6	1915	.....	.....
Enterprise Ry. Co.....	.....	50,000	J. & J.	5	1906	.....	.....

NEW ORLEANS STOCKS AND BONDS.—Corrected by GEORGE LE SASSIER, 174 Common Street, New Orleans, La., May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Carrollton R. R. Co	100	800.000	Quart.	1½	1867	135	139
Crescent City R. Co.....	100	1,150,000	"	1¾	.866	97½	98¾
Canal & Claiborne R. R. Co..	40	240,000	.....	...	1888	22	26
New Orleans City & Lake Co.	100	1,500,000	Quart.	1¾	1860	130	131
Orleans R. R. Co.....	50	185,000	"	2	1868	55	62
St. Charles Street R. R. Co ..	50	600,000	"	3	1866	8·¾	91

Bonds.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Canal & Claiborne Sts. R. R.	1879	150,000	A & O	6	1887	102¼	.....
Crescent City R. R. 1st Mort.	1883	100,000	M & N	6	'93–'99	.....	.....
do do new	1886	40,000	M & N	6	1896	.. .	.....
N. O. City R. R. Co.....	1879	495,200	J & D	6	1903	121	.....
N. O. & Carrollton R. R. Co..	1882	300,000	F & A	6	'92–'06	113½	.....
St. Charles Street R. R. Co...	1881	165,000	J & D	6	'89–'01	.....	.....

NEW HAVEN STOCKS AND BONDS.—Corrected by H. C. WARREN & Co., Bankers and Brokers, New Haven, Conn. May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
F. Haven & Westville R. R. Co.	25	$30),000	J. & J.	4	.....	25	.....
State Street Horse R. R. Co....	25	23,000	J. & J.	3	.....	25	.....
New Haven & W. Haven R. R. Co	25	. .....	.....	...	.....	26	.....
New Haven & Cent'lle H. R. Co.	.....	.....	.....	...	.....	.....	.....
Whitney Ave. Ry. Co.....	50	25,000	.....	...	.....	7	.....
Bridgeport Horse R. R. Co.....	100	140,000	.....	...	.....	.....	.....
Hartford & Westfield Horse R. R. Co.....	100	200,000	J. & J.	3	.....	125	.....

BONDS.	Date of Issue	Amo'nt Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
State Street Horse R. R. Co...	1874	20,000	J. & J.	7	Jan., 1894	104	.....
New Haven & W. Haven R. R. Co	1889	50.000	J. & J.	5	July, 1899	100	.....
Bridgeport Horse R. R. Co.....	.....	50,000	.....	6	.....	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series A.....	1888	100,000	M. & S.	5	Sept., 1908	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series B....	1890	100,000	M. & N.	5	May, 1910	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series C. (Not yet issued).....	.....	100,000	M. & N.	5	May, 1910	.....	.....

MONTREAL STOCKS AND BONDS.—Corrected by GORDON STRATHY & Co., Members Montreal Stock Exchange, 9 St. Sacrament Street, May 18. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Montreal St. Ry.(p'd up sh.)	50	$900,000	M. & N.	4	May, '91.	199	210
BONDS.	Date of Issue	Amount Out-standing.	Interest Period.	%	Principal Due.	Bid.	Ask'd
Montreal St. Ry	1885	£60,000	.....	5	1965	.....	.....

LOUISVILLE STOCKS AND BONDS.—Corrected by ALMSTEDT BROS. Stock and Bond Brokers, 510 West Main Street, Louisville, Ky., May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Louisville St. Ry, Co., pref...	100	$1.000.000	A. & O.	5	Jan. 1891	79	80
Louisville St. Ry. Co., com....	100	5,000.000	.....	...	Jan. 1891	22	23
BONDS.	Date of Issue	Amount Out-stand-ing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Louisville St. Ry. Co., 1st mort	1890	6,000,000	J. & J.	5	1930	94	95
Louisville City Ry. Co. Cons .	1884	1,000,000	J. & J.	6	1909	113	.....
Central Passenger Ry. Co....	1888	400,000	M. & N.	6	1908	113	.....
New Albany St. Ry. 1st Mort.	1888	150.000	J. & J.	6	1913	95	100

CHICAGO STOCKS AND BONDS.—Corrected by WILLIAM B. WRENN, 82 Washington Street, Chicago, Ill., May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Chicago City	100	$7,000,000	Q.—J.	3	.....	347	350
Chicago Passenger	100	1,000,000	A. & O.	2½	.....	97	.....
North Chicago City	100	500,000	Q.—J.	7½	.....	500	.....
North Chicago Street	100	5.000,000	J. & J.	4	.....	194	194½
West Division City	100	1,250,000	Q.—J.	8¾	.....	635	.....
West Chicago Street	100	10,000,000	Q.—F.	1½	.....	142	142½
BONDS.	Date of Issue	Amount Out-stand-ing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Chicago City	.....	4,619,500	J. & J.	4½	.....	98½	99
Chicago Passenger	1883	400,000	F. & A.	6	1903	109	.....
North Chicago City, 1st mort.	.....	500,000	M. & N.	6	1900	.....	112
" " "	.....	1,640.000	M. & N.	4½	1927	95¾	.....
North Chicago Street 1st mort	.....	2,350,000	J. & J.	5	1906	100¾	.....
West Division Railway	.....	3,790,000	J. & J.	5	.....	101	.....
" " " Ext.	.....	250.000	J. & D.	6	.....	100	.....
West Chicago Street	.....	4,160.000	M. & N.	5	.....	101¼	101¾
West Chicago Street, Tunnel.	.....	1,500,000	F. & A.	5	.....	95½	.....

PITTSBURGH STOCKS AND BONDS.—Corrected by KEA BROS. & Co., 115 Fourth Avenue, Pittsburgh, Pa., Members of New York, Philadelphia and Pittsburgh Stock Exchanges, May 18. Stock quotations are prices per share

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Central Traction R. R. Co....	50	1,500,000	.....	...	.....	29½	30
Citizens' Traction R. R. Co ..	50	3,000.000	J. & J.	3	.....	62½	62¾
Pitts. & Birmingham R. R. Co	50	3,000,000	.....	...	.....	27½	27⅞
Pittsburgh Traction R. R. Co.	25	2,500,000	J. & J.	...	.....	57	.....
Federal St. & Pleasant Valley	25	1,400,000	J. & J.	3	.....	25	25⅛
Pittsburgh, Allegheny & Man	50	3,000,000	.....	...	.....	.....	44¼
West End R. R. Co	50	200,000	J. & J.	...	.....	.....	.....
Duquesne Traction Co	50	3,000,000	J. & J.	3	.....	.....	50
Second Avenue R. R. Co.....	50	300,000	.....	...	.....	29¼	29¾
Penn Incline Plane Co	50	250,000	.....	...	.....	.....	.....
Monongahela Incline Plane Co	50	140,000	F. & A.	...	.....	.....	.....
Fort Pitt Incline Plane Co...	50	60,000	.....	...	.....	.....	.....
Mount Oliver Incline Plane Co	50	100,000	.....	...	.....	.....	.....
Pittsburgh Incline Co	100	150,000	.....	...	.....	.....	.....
BONDS.	Date of Issue	Amount Out-standing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Citizens' Traction R. R. Co ..	1887	1,250,000	A. & O	5	1927	108½	109½
Pitts. & Birmingham Traction Co	1889	1,500,000	M. & N.	5	1929	101¼	101½
Pittsburgh Traction R. R. Co.	1887	750,000	A. & O.	5	1937	105	.....
Pleasant Valley Ry	1891	1,250,000	J. & J.	5	1919	.....	102
P., A. & M. R. R. Co	1891	1,500 000	J. & J.	5	1931	104½	105½
Duquesne Traction Co	1890	1,500,000	J. & J.	5	1930	101⅝	101⅞
Second Ave. Electric R. R. Co	1889	1,500,000	J. & J.	5	1909	.....	.....
Central Traction Co	1889	375,000	J. & J.	5	1919	.....	.....
Union R. R. Co	1881	100,000	A. & O.	5	1901	.....	.....
West End R. R. Co	1887	75.000	J. & J.	5	1907	.....	.....
Fort Pitt Incline Plane Co...	1881	30,000	.....	6	1901	.....	.....
Mount Oliver Incline Plane Co	1871	44,500	M. & N.	6	1901	.....	.....
Penn Incline Plane Co. 1st Mort	1883	125,000	.....	6	1903	102½	.....
Monongahela Incline Plane Co	1887	50,000	A. & O.	5	1892	.....	.....
Monongahela Incline Plane Co.	1887	50,000	A. & O.	5	1897	.....	.....
Pittsburgh Incline Co	1889	250,000	J. & J.	6	1919	.....	.....

SAN FRANCISCO STOCKS AND BONDS.—Corrected by PHILIP BARTH, Broker, 410 California Street, San Francisco, Cal., May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
City R. R. Co	100	800,000	.....	...	.....	.....	100
California St. Cable Co	100	1,000,000	Monthly	5	.....	115	116½
Central R. R. Co	100	1,000,000	.....	...	.....	.....	12
Geary St., Park & Ocean R.R.Co	100	1,000,000	.....	1	.....	95	.....
North Beach & Mission Ry. Co	100	1,000,000	.....	...	.....	50	75
Ferries & Cliff House R. R. Co.	100	2,500,000	.....	...	.....	37	40
Omnibus Cable Co	100	2,000,000	Monthly	4	.....	58	60
Presidio & Ferries R. R. Co....	100	1,000,000	.....	...	.....	22	.....
Bonds.	Date of Issue	Am't Out-stand-ing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Ferries & Cliff House	.....	650,000	M. & S.	6	1914	100¼	110
Market Street R. R	.....	3,000,000	J. & J.	6	913	122½	124
Omnibus R. R	.....	2,000,000	A. & O.	6	1918	113½	.....
Powell Street R. R	.....	700.000	M. & S.	6	1912	110½	.....
Park & Ocean R. R	.....	250,000	J. & J.	6	1914	113¾	.....
Park & Cliff House R. R	.....	350,000	J. & J.	6	.....	94	99
Cal. St. Cable R. R	.....	.....	.....	...	.....	103⅝	.....

ST. LOUIS STOCKS AND BONDS.—Corrected by JAMES CAMPBELL, Banker & Broker, 307 Pine st., St. Louis, Mo., May 18. Stock quotations are prices per share.

Company.	Par.	Capital Issued.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Benton-Bellefontaine	100	$324,000	Q.—J.	3	1864	102	103
Cass Ave. & Fair Grounds	50	300,000	.....	...	1876	44½	45½
Citizens'	100	1,500,000	A. & O.	1½	1887	100	105
Jefferson Avenue	100	112,000	.....	..	1885	102	105
Lindell	100	2,500,000	Q.—J.	...	1890	56	60
Missouri	100	2,000,000	Q.—J.	2	1891	225	250
Mound City	100	1,000,000	.....	..	1890	190	200
Northern Central	100	200,000	.....	...	1884	100	105
People's	50	1,000,000	M. & S.	6	18-9	40	45
St. Louis	100	1,000,000	J. & J.	6	1890	250	275
4th Street & Arsenal	50	150,000	Jan.	.50	1872	15	25
Union	50	600,000	.....	...	1870	20	25
Union Depot	100	1,200,000	.....	...	1890	200	250
St. Louis & Suburban	100	2,500,000	.....	...	1891	48	50
BONDS.	Date of Issue	Amount Out-stand-ing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Benton-Bellefontaine	1880	$500,000	F. & A.	6	1900	102	102½
Cass Avenue	1886	200,000	F. & A.	6	1906	100	101
Citizens' Cable	1887	1,500,000	J. & J.	6	1907	107	108
Lindell	1890	1,500,000	J. & J.	5	1895-1910	99	100
Mound City	1890	525,000	A. & O.	6	1900-1910	105	106
Missouri Cable	1887	500,000	M. & S.	6	1907	102	105
People's 1st mort	1882	125,000	J. & D.	6	1902	102	105
" 2d mort	1886	75,000	M. & N.	7	1902	104	105
People's Cable	1889	800.000	J. & J.	6	1889-1914	97½	100
Northern Central	1884	200,000	J. & J.	6	1904	100	101
St. Louis Cable	1890	1,500,000	M. & N.	5	1900-1910	97½	98
Union	1885	150,000	M. & N.	6	1895-1915	102	103
Union Depot	1890	1,600.000	A. & O.	6	1900-1910	105	106

PHILADELPHIA SECURITIES.—Corrected by ROBERT GLENDINNING & Co., 143 South Fourth st. (Bullitt Building), Philadelphia, May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS							
Citizens'	50	$500,000	Q.—J.	4	1858	260	270
Continental	50	1,000,000	J.—J.	6	1873	120	122
Frankford & Southwark	50	1,250,000	Q.—J.	5	1854	210	212
Germantown	50	1,500,000	Q.—J.	2½	1858	99	100
Green & Coates	50	500,000	Q.—J.	3	1858	118	120
Hestonville	50	2,050,000	.....	...	1859	34	36
Lombard & South	25	500,000	A.—O.	8	1861	55	58
People's Common	25	1,500,000	M.—S.	2½	1873	49	50
" Preferred	25	750,000	M.—S.	2½	.....	49	.....
Philadelphia City	50	1,000,000	J.—J.	7½	1859	150	151
Philadelphia & Gray's Ferry	50	617,500	J.—J.	3½	1858	65	70
Philadelphia Traction (50 pd.)	50	5,000,000	M.—N.	3	1883	82	86
Ridge Avenue	50	750,000	Q.—J.	5	1872	220	230
Second & Third	50	1,060,200	Q.—J.	5	1853	160	162
Thirteenth & Fifteenth	50	1,000,000	J.—J.	9	1858	196	200
Union	50	1,250,000	J.—J.	9½	1864	170	180
West Philadelphia	50	750,000	J.—J.	10	1857	185	190
Metropolitan (N.Y.) Traction	100	20,000,000	Q.—F.	1	.....	112	114
Baltimore Traction	25	5,000,000	.....	1	1889	20½	21
Buffalo (N. Y.) Railway	100	6,000,000	.....	...	.....	34	36
Newark (N. J.) Passenger	100	6,000,000	.....	...	.....	29	30
BONDS.	Date of Issue	Amount Out-standing	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Baltimore Traction 1st Mort.	1889	1,500,000	M.—N.	5	1929	109	110
" " Imp.	1892	1,250,000	M.—S.	6	1901	102½	.....
Germantown, 1st mort	.....	67,000	J.—D.	5	1904	103	.....
" 2d mort	.....	160.000	A.—O.	5	1899	103	.....
Hestonville, 1st mort	.....	300.000	M.—N.	6	1895	104	.....
" " "	.....	124.500	J.—J.	6	1901	105	.....
" 2d mort	.....	75,000	M.—S.	6	1902	103	.....
People's, 1st mort	.....	219,000	J.—J.	7	1905	115	.....
" " "	.....	285,000	J.—J.	5	1911	100	.....
" Cons. mort	.....	247,000	M.—S.	5	1912	95	.....
West Philadelphia, 1st mort	.....	246,000	A.—O.	6	1906	117	.....

OMAHA STOCKS AND BONDS.—Corrected by RICHARD C. PATTERSON, Banker and Broker, 907 N. Y. Life Building, Omaha, Neb., May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Omaha St. Ry. Co.	100	5,000,000	M. & N.	....	Jan. 1, '89	60	.....

BONDS.	Date of Issue	Am't Out-standing.	Inter'st Paid.	%	Principal Due.	Bid.	Ask'd
Omaha St. Ry. Co.	1889	2,250,000	M. & N.	5	M'y 1, 1914	95	98

CINCINNATI STOCKS AND BONDS.—Corrected by GEO. EUSTIS & Co., Bankers and Brokers, 26 West Third Street, Cincinnati, May 18. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Cincinnati	50	$6,000,000	Q.—J.	5	.....	110¾	111
Mt. Adams & Eden Park	50	1,400,000	Q.—J.	5	.....	110	110½
S. Covington & Cincinnati	50	275,000	J. & D.	6	.....	118	120
Mt. Auburn Cable	100	300,000	.....	...	.....	.....	40
Cin. Inclined Plane Ry	100	500,000	.....	...	.....	77	78
" " " Pref.	100	100,000	.....	6	.....	98	99

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Cincinnati Street	.....	50,000	J. & J.	7	July, 1892	100½	102½
" "	.....	50,000	J. & J.	7	July, 1893	102	.....
" "	.....	50,000	J. & J.	7	July, 1894	104	.....
" "	.....	50,000	J. & J.	7	July, 1895	.....	110
" "	.....	50,000	J. & J.	7	July, 1896	108	112
" " extended	.....	100,000	J. & J.	4	July, 1896	....	101
	.....	50,000	J. & J.	5	July, '96	101	103
Mt. Adams & Eden Park	.....	50,000	A. & O.	6	July, 1895	.....	.....
" " "	.....	50,000	A. & O.	6	July, 1900	104½	.....
" " "	.....	100,000	A. & O.	6	July, 1905	.....	.....
" " 10-20's	.....	200,000	J. & D	6	Je. '94-1924	105½	.....
" " Cable	.....	250,000	M. & S.	5	Mar. 1906	104½	105
Cin. Inclined Plane Ry	.....	125,000	J. & J.	7	July, 1899	115	.....
" " " "	.....	300,000	J. & J.	6	Jan. 1914	107	108
Mt. Auburn Cable	.....	200,000	J. & D.	5	June, 1907	90	92½
" " 5-20's 2d	.....	100,000	A. & O.	7	Ap. '93-1908	95	100
S. Covington & Cincinnati	.....	250,000	M. & S.	6	Mar. 1912	110	114

BALTIMORE STOCKS AND BONDS.—Corrected by HAMBLETON & Co., Bankers, 9 South Street, Baltimore, Md., May 19. Stock quotations are prices per share,

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Balto. City Pass. Ry. Co.	25	1,000,000	Quart.	3	.....	75	80
Union Pass. Ry. Co.	50	750,000	.....	...	.....	.....	.....
Balto. Traction Co. (Cable)	25	5,000,000	Quart.	1	.....	21	21½

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Central Pass. Ry.	1882	250,000	J. & J.	6	1912	113	114
Union Ry. Co. 1st mort.	.....	50,000	M. & N.	6	.....	105	110
" " cons. mort.	.....	1,500,000	.....	5	.....	93	100
Balto. Traction Co. (Cable)	1889	1,500,000	M. & N.	5	1929	109¾	110
City Pass. R. R. Co.	1891	2,000,000	"	5	1911	110¾	111

WASHINGTON STOCKS AND BONDS.—Corrected by CRANE, PARRIS & Co., Bankers, 1314 F Street, N.W., Washington, D. C., May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Wash'ton & Georgetown R.R.	50	500,000	Q. E.	...	1863	275	.....
Metropolitan R. R.	50	750,000	Q. J.	...	1864	95	105
Columbia R. R.	50	400,000	Q. M.	...	1870	60	65
Capitol & North O St. R. R.	50	500,000	Q. J.	...	1875	40	45
Eckington & Soldiers' Home	50	352,600	.....	...	.....	40	43
Georgetown & Tenallytown	50	200,000	.....	...	.....	.....	95
Rock Creek R. R.	100	401,700	.....	...	.....	100	.....
Glen Echo R. R.	50	100,000	.....	...	.....	.....	.....

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Washington & Georgetown	1883	500,000	J. & J.	6	1893-1923	102	.....
do. do. convert.	'83-'91	3,000,000	J. & J.	6	1899-1929	149	150
Eckington & Soldiers' Home	.....	156,000	J. & D.	6	1896-1911	100	.....
Capitol & North O St. R. R.	1891	240,000	J. & J.	5	1921	105	109
Metropolitan R. R. convert.	1891	200,000	J. & J.	6	1901	110	119

ROCHESTER, BUFFALO, PATERSON AND NEWARK STOCKS AND BONDS.—Corrected by E. W. CLARK & Co., 139 So. Fourth St. (Bullitt Building), Philadelphia, May 18.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid	Ask'd
STOCKS.							
Rochester (N.Y.) Ry.	100	5,000,000	.....	...	1890	35	37
Buffalo (N.Y.) Ry.	100	6,000,000	.....	...	1891	38	40
Paterson (N. J.) Ry.	100	1,250,000	.....	...	1891	.....	25
Newark (N. J.) Pass. Ry	100	6,000,000	.....	...	1890	24	26

BONDS.	Date of Issue	Amount Out standing.	Inter-est Paid.	%	Principal Due.	Bid	Ask'd
Rochester (N.Y.) Ry.	1890	3,000,000	A & O	5	1930	90	95
Buffalo (N.Y.) Ry.	1891	5,000 000	F & A	5	1931	94	97½
Paterson (N. J.) Ry.	1891	850 000	J & D	6	1931	....	100
Newark (N. J.) Pass. Ry	1890	6,000 000	J & J	5	1930	89¾	90

CLEVELAND STOCKS.—Corrected by W. J. HAYES & SONS, Bankers, Cleveland, O., May 18. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Broadway & Newburgh R. R.	100	1,000,000	.....	....	.....	106	110
Brooklyn St. R. R.	100	310,000	.....	2	.....	170	175
Cleveland City Cable, common	100	4,000,000	.....	....	.....	22½	25
" " pref'd	100		.....	....	.....	95	105
East Cleveland R. R.	50	2,000,000	Quart.	1½	.....	82½	85
Woodlawn Ave. & West Side	100	1,100,000	Quart.	1½	.....	145	150

Financial.

THE Niagara Falls (N. Y.) Street Railroad Co. have voted to increase their capital stock from $100,000 to $250,000.

$ $ $

THE St. Joseph (Mich.) & Benton Harbor Street Railway Co. have decided to issue bonds to the amount of $150,000, to be secured by a trust deed covering all the company's property.

$ $ $

THE stockholders of the Braintree (Mass.) Street Railway Co. have voted to petition the Railroad Commissioners for permission to increase the capital stock to an amount not exceeding $100,000.

$ $ $

THE West End Street Railway Co. of Boston, sold during the first week of May 8,000 shares of new common stock at auction for $577,506, the prices ranging from $72.12 to 72.37 per share. The par value is $50 per share.

$ $ $

THE stockholders of the Fort Wayne & Elmwood Street Railway Co. of Detroit, Mich., have voted to reorganize, as the company has a corporate life of only three years more, while their franchise runs for seventeen years or longer.

$ $ $

THE New York State Board of Railroad Commissioners has approved the application of the Seneca Electric Railway Co. for permission to increase their capital from $40,000 to $50,000, the increase to be used in bettering and increasing the road's equipment.

$ $ $

LAST month the Central Railway Co. of Baltimore (Md.) arranged for a mortgage of $700,000 with the Mercantile Trust & Deposit Co. to cover the issue of 700 $1,000 bonds. 250 of these will be used to take up existing mortgage bonds and the balance will cover the expense of the electrical equipment.

$ $ $

THE quarterly report of the Brooklyn (N. Y.) City Railroad Co. for the quarter ending March 31, 1892, reads as follows: Gross earnings, $803,135.03; operating expenses, $692,465.32; net earnings, $110,669.71. Fixed charges as follows: Interest on funded debt, $50,346.90; taxes on property, $30,000.00; taxes on earnings and capital, $8,100.00; net income, $22,222.81.

$ $ $

THE stockholders of the Federal Street & Pleasant Valley Passenger Railway Co., of Pittsburgh, Pa., voted last month to issue $100,000 new stock with which to take up the $400,000 stock of four of its lateral branch lines, and $325,000 bonds with which to complete its system. The capital stock will now stand at $1,400,000, while the bonded indebtedness will be only $1,250,000—$2,650,000 in all.

$ $ $

THE Consolidated Street Railway Co. of Sacramento, Cal., have sold to N. W. Harris & Co., bankers, $250,000 of the first mortgage, 6 per cent. gold bonds.. The net earnings of the system for the past year are stated to have been $41,848 over operating expenses and taxes. The principal part of the proceeds of the bonds is to be applied to completing the system as an electric street railroad.

THE annual stockholders' meeting of the Southington (Conn.) & Plantsville Tramway Co. was held last month and the report of Secretary L. E. Southworth showed: Total car receipts, $5,166.98; received for lights, $3,759.53; from rental of power, $59.00; number of lights, 462; number of passengers carried in 1890, 110,740; number of passengers carried in 1891, 103,339; net financial gain for the year, about $600.00.

$ $ $

THE Essex Electric Street Railway Co., of Salem, Mass., have petitioned the State Railroad Commissioners for leave to increase their issue of bonds from $100,000 to $180,000. The road is capitalized at $50,000. Civil Engineer Thomas Doane presented a statement of the present property of the road, amounting to $178,849. It is proposed to add electric equipment, buildings, etc., making the entire value $233,038.

$ $ $

THE directors of the Worcester, Leicester & Spencer Street Railway Co. declared, May 4, a dividend to the stockholders of $3 a share, based on the profits of the road during the eight months of its operation. The treasurer's report showed for the period: Total receipts, $53,402.62; total expenses, $36,129.13; profit, $17,273.49. The company are considering the question of increasing the capital stock $125,000.

$ $ $

THE Boston (Mass.) & Revere Electric Street Railway Co. have petitioned for leave to issue $75,000 new capital stock, and $75,000 additional bonds, bringing their total capitalization up to $250,000.

The money is needed to make a through road to connect at Winthrop Junction for Boston proper. The present road is operated only three months of the year. It is now intended to operate the year round. The bonds will bear interest at 5 per cent.

$ $ $

THE Sixth Avenue Railroad Co. of New York City, report for the quarter ending March 31: Gross earnings, 1892, $57,266; 1891, 177,736; decrease, $120,470; operating expenses, 1892, $36,658; 1891, $117,827; decrease, $81,169; net earnings, 1892, $20,608; 1891, $59,969; decrease, $39,301; other income, 1892, $333; 1891, $233; increase, $100; total income, 1892, $20,941; 1891, $60,142; decrease, $39,201; fixed charges, 1892, $5,116; 1891, $17,000; decrease, $11,884; surplus, 1892, $15,825; 1891, $45,323; decrease, $29,398. The company report the cash on hand $92,161, and a profit and loss surplus of $94,433.

$ $ $

AT a meeting of the directors of the Pittsburgh Traction Co., of Pittsburgh, Pa., held May 6, the vacancies on the Board caused by the resignations of Thomas S. Bigelow and Joseph G. Wainwright were filled by the election of C. L. Magee and Wm. Flinn. A dividend of 3 per cent. on the capital stock of the company, which amounts to $1.50 share, was declared payable on and after May 15. P. A. B. Widener and Willlam L. Elkins were present, and the directory, as now constituted, is as follows: George W. Elkins, C. L. Magee, P. A. B. Widener, William Flinn, William L. Elkins and George W. Wilson.

It was decided to largely increase the facilities of the Forbes Street portion of the Duquesne traction line, and more cars will be placed on that branch.

$ $ $

THE Lake Street Elevated Railway Co., of Chicago, have certified to an increase of capital stock from $3,000,000 to $5,000,000. The West Division railway of the same city are, it is understood, contemplating the issue of a 4½ per cent. first mortgage bond to take up their outstanding 5 per cent. debenture bonds, which were issued in 1887, and are optional after July, 1892, amounting to $4,040,000. Such an issue would decrease the annual interest charges of the company to the benefit of the West Chicago Street Railroad Co., who day the interest on the bonds under the lease agreement. A financial paper of Chicago says: "The bonds would undoubtedly meet with a ready sale, and be a favorite with the public if made as contemplated—twenty-five to forty years without option and payable in gold."

SPECIAL NOTICES.

FOR SALE.

FOR SALE.—30 twelve-foot cars, one-end type, with one fare box; in fair order. Gauge 4 ft. 8½ in. For all particulars apply to METROPOLITAN RAILROAD CO., Washington, D. C.

FOR SALE—STREET CARS.—On account of increase of business calling for larger cars, we have for sale 9 twelve-foot double-end, box cars, with fare box in each end. Gauge 4 feet 8½ inches. Apply to UNION STREET RAILWAY CO, New Bedford, Mass.

POSITIONS WANTED.

WANTED.—A position as Superintendent or Assistant with an Electric Road, by a young man thoroughly competent in all branches. Address J. E. M., P. O. Box 792, Syracuse, N. Y.

WANTED.—Position as electrical engineer for street railway or electric light plant. Seven years experience; can give best of references. Address "J. W.," care STREET RAILWAY JOURNAL, New York.

WANTED.—Position as M. M. or Superintendent of an Electric Railroad by man who has had large experience in steam and electric railroading. At present superintendent electric railway equipment factory. Address "RAILROADER," care of STREET RAILWAY JOURNAL, New York.

WANTED.—By first-class armature winder, position with railway company. Long experience in principal systems; can do anything in the business. A No. 1 references, and satisfaction guaranteed. Address "COMPETENT," care STREET RAILWAY JOURNAL, 535-537 Rookery, Chicago, Ill.

MISCELLANEOUS.

WANTED—To trade six miles No. 1 electric equipment for horses and cars or horse car equipment complete. Satisfactory reasons given on application. "TRADER," care STREET RAILWAY JOURNAL, New York. 3t

A New Electric Railway Company.

The Carbondale Traction Co. is the name of a corporation recently organized and building a road 8½ miles long in Carbondale, Pa. The contract for the entire roadbed construction, girder and T rails and all curves and special work has been given to the Johnson Co. The Thomson-Houston Electric Co. will supply the motors. Six Brill cars will each be equipped with two W. P. 30 H. P. Thomson-Houston motors, and two Edison generators with Frick Corliss engines will supply the power. The Thomson-Houston company will also do all the construction work. Nearly three miles of track are completed and the road will be running by June 20. The company was organized by A. H. Chadbourne, who represents the Thomson-Houston company in their Philadelphia office. The road runs from Simpson, through Carbondale, Mayfield, Mayville and Jermyn to Archbald and will supply 30,000 people with a much needed rapid transit. The capital has been supplied largely by gentlemen outside of Carbondale who are interested in various other roads in the state.

A Luxurious Car.

Speaking of the Private Compartment Cars, we quote from the San Francisco *Daily Report* of January 20, 1892, the car being identical with those in daily service on the New York & Chicago Limited over the Lake Shore Route :

" Isn't this too lovely for anything !" exclaimed a very pretty Oakland girl yesterday afternoon as she entered the Wagner compartment car attached to the Wagner vestibule train of sleepers which brought out the Eastern press delegates last week.

A D. R. reporter, standing near, at once became interested, for whatever receives so favorable a comment from an æsthetic damsel residing in the Athens of the Pacific must needs be lovely. The girl was right. Standing in one of those luxurious compartments, with everything so bright, attractive and comfortable, an irresistible desire to travel in a Wagner car seized the reporter. "All the comforts of home" and everything that the heart of the traveler could desire was there. Hot and cold water within two feet of him as he reclined indolently on what in the daytime was the most comfortable of lounges and at night is miraculously changed into the softest and most sleep inducing kind of bed. Cut off from the curious stare of his fellow travelers, the tourist can gaze his fill at the passing scenery and, when wearied of that, he can turn his gaze inward and amuse himself by wondering how the ingenuity of the Wagner people must have been taxed to devise so many comfortable things and put them in so small a space.

Even the most æsthetic tastes could not find subject matter for offense in a Wagner compartment car. All the colors blend nicely, the dark, handsomely stained wood of the car harmonizes with the elegant frieze covering of the seats.

The compartment car is in the same style as those run on the famous limited train between New York and Chicago. It has ten connecting staterooms, furnished in different styles of woods, upholstered with silk damask to correspond with the wood. The seats are covered with the finest kind of frieze plush.

The car is steam heated, and each compartment is lighted by gas and contains a lavatory, hot and cold water, closet, etc.

Oh, yes—the reporter forgot about that pretty Oakland girl. He was just in time to catch her last sentence as she stepped off the train, and this was it, honor bright : " I vow, I'll never travel in a Pullman sleeper again."

A Choice List of Summer Resorts.

In the Lake regions of Wisconsin, Northern Michigan, Minnesota, Iowa and the two Dakotas, there are hundreds of charming localities pre-eminently fitted for summer homes. Among the following selected list are names familiar to many of our readers as the perfection of Northern summer resorts. Nearly all of the Wisconsin points of interest are within a short distance from Chicago or Milwaukee, and none of them are so far away from the "busy marts of civilization" that they cannot be reached in a few hours of travel, by frequent trains, over the finest roads in the Northwest—the Chicago, Milwaukee & St. Paul Railway, and Milwaukee & Northern Railroad :

Oconomowoc, Wis.	Marquette, Mich.
Minocqua, Wis.	Clear Lake, Iowa.
Waukesha, Wis.	Lakes Okoboji, Iowa.
Palmyra, Wis.	Spirit Lake, Iowa.
Tomahawk Lakes, Wis.	Frontenac, Minn.
Lakeside, Wis.	Lake Minnetonka, Minn.
Kilbourn City, Wis. (Dells of the Wisconsin).	Ortonville, Minn.
	Prior Lake, Minn.
Beaver Dam, Wis.	White Bear Lake, Minn.
Madison, Wis.	Lake Madison, So. Dakota.
Delavan, Wis.	Big Stone Lake, So. Dakota.
Sparta, Wis.	Elkhart Lake, Wis.
Pewaukee, Wis.	Ontonagon, Mich.
Wausaukee, Wis.	Mackinaw, Mich.

For detailed information, apply to any coupon ticket agent, or send stamp for a free illustrated tourist folder, to Geo. H. Heafford, General Passenger Agent, Chicago, Ill.